Chinese Journal of Experimental Traditional Medical formulae

COMPARATIVE STUDY OF SEPSIS SCRENNING: CORD BLOOD AND NEONATAL BLOOD IN NEONATES WITH RISK FACTORS FOR EARLY ONSET NEONATAL SEPSIS

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ABSTRACT

BACKGROUND:
Neonatal sepsis remains a formidable challenge in neonatology, accounting for a substantial portion of global infant mortality. Despite its global impact, neonatal sepsis contributes to an alarming 50% of deaths in developing nations. This study compares parameters such as CBC, CRP between neonatal blood and umbilical blood in neonates with risk factors for early onset neonatal sepsis and explores the significance of umbilical cord blood as a diagnostic tool for diagnosing early onset sepsis.

METHODOLOGY:
It's a cross-sectional study conducted at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital between January 2022 and December 2022, and focuses on 150 neonates admitted to the neonatal unit with risk factors for early onset sepsis. Ethical considerations and privacy maintenance were paramount throughout the study.

RESULTS:
Out of 150 participants' mothers, 13(9%) had maternal fever, 55(37%) experienced rupture of membranes for more than 18 hours, 64(43%) had single unclean or more than 3 sterile vaginal examinations during labor and 41(27%) experienced prolonged labor. Clinical sepsis was diagnosed in 50(33%) neonates, with Staph aureus infections dominating. Sepsis indicators like total count, absolute neutrophil count and CRP showed positive corelation between umbilical and neonatal blood with statistical significance ($p<0.0001$).

CONCLUSION:
Hematological indicators demonstrated similarity in umbilical and neonatal blood, suggesting time-efficient diagnostic potential. Umbilical cord blood proved as a significant aiding tool in diagnosing bacterial sepsis in high-risk newborns

Keywords: Umbilical cord blood, Early-onset sepsis, Maternal risk factors, Diagnostic indicators

INTRODUCTION:

Neonatal sepsis, a bloodstream infection in infants under 28 days old, has long been a challenge in neonatology. Despite constituting 25% of global deaths[1], neonatal sepsis contributes to 50% of fatalities in developing nations. Even with intensive care, 20% of preterm and 2% of term infants succumb to early-onset sepsis[2,3]. Distinguishing between early-onset sepsis and late-onset sepsis (LOS) is crucial, with early onset sepsis primarily linked to infections transmitted during childbirth. Group B streptococcus(GBS), Escherichia coli, and other bacteria pose common threats[4]. Maternal risk factors for early onset sepsis include chorioamnionitis, GBS infection, preterm birth, and prolonged rupture of membranes.

The immunological immaturity of newborns complicates sepsis diagnosis, emphasizing the need for alternative diagnostic markers. It is our current practise to base the decision to begin antibiotics on absolute neutrophil count, C-reactive protein, erythrocyte sedimentation rate, I:T ratio, pending the results of a 48-hour blood culture[5]. While blood cultures remain the gold standard, challenges in accessibility and reporting time necessitate alternative diagnostic approaches. Umbilical cord blood, if proven equivalent to systemic newborn blood, could offer a less invasive diagnostic option.

When blood is drawn using the right procedures, one study on the subject reveals a satisfactory correlation between cord and newborn blood culture results with a false positive cord blood culture rate of only 0.5%.[6]

Therefore, our study investigates the correlation between WBC/differential and CRP data from umbilical cord and newborn blood, aiming to establish the utility of umbilical cord blood count in diagnosing neonatal sepsis compared to peripheral venous blood.

Hence objective of my study was to correlate the use of Umbilical cord blood count in diagnosis of neonatal sepsis as compared to peripheral venous blood

METHODOLOGY:

This cross-sectional study investigates neonates with risk factors for early-onset neonatal Sepsis, conducted at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital in Salem, Tamil Nadu, between January 2022 and December 2022. The study focused on neonates admitted to the neonatal unit, utilizing specific inclusion criteria such as single unclean or >3 sterile vaginal examinations during labour, Prolonged labour > 20 hours, Intrapartum fever >37.5 degree C/ Increased maternal leucocyte count, Chorioamnionitis, Rupture of membranes/ PV leak >18 hours, Foul smelling liquor. All newborns without maternal risk factors for early onset sepsis were excluded.

Neonates meeting risk criteria, identified from maternal records, were selected. The first 150 eligible neonates were included. Informed consent was obtained.. Cord blood was obtained using a sterile technique, and laboratory tests were conducted for CBC and CRP. Blood samples were collected from the peripheral venous line using 70% isopropyl alcohol for sterilization and sent for CBC, CRP and blood culture.

The study received ethical approval from the Institutional Ethics Committee. Privacy and confidentiality were strictly maintained, ensuring participant data were used exclusively for research purposes.

Data were analysed using Microsoft Excel and IBM SPSS 23.0. Descriptive statistics, including frequency and percentage analyses, characterized discrete variables. Continuous variables were assessed using mean, median, and standard deviation. The Chi Square test or Fisher's exact test was applied for discrete variables, while the Independent T test examined differences in continuous variables. A significance level of 0.05 was adopted for all statistical analyses.

RESULTS:

Out of the 150 participants, 84(56%) were female and 66(44%) were male. The mean weight of the study participants' mothers were 65.8 kg, with the mean hemoglobin (Hb) level for the mothers were11.6 grams. A majority of the mothers 71(47.3%) belonged to blood group A, and 116(77%) were Rh-positive. The prevalence of Lower Segment Caesarean Section (LSCS) among the mothers was 73 (49%). The mean birth weight of the participants was 2.71 kg, with a standard deviation of 0.49 kg. Notably, the prevalence of maternal fever among the mothers of the study participants was 13(9%). And also, that 55(37%) experienced rupture of membranes for more than 18 hours. Out of the 150 participants 64(43%) had single unclean or more than 3 sterile vaginal examinations during labor and 41(27%) experienced prolonged labor and 25(17%) had meconium stained liquor. Among the participants, 54(36%) were classified as preterm, while 96(64%) experienced term births. Additionally,13(9%) of the participants underwent resuscitation, with 7(5%) experienced respiratory distress. Moreover, 8(5%) of participants experienced birth asphyxia. The distribution of participants according to the color at birth showcased that all participants displayed a remarkable pink color at birth.

The mean Hemoglobin value of the study participants taken from cord blood was 11.745 grams with the standard deviation of 1.09 grams. The mean Haemoglobin value of the study participants taken from neonatal blood was 12.9grams with the standard deviation of 1.2 grams. Out of the total participants, 100 individuals (66.7%) did not exhibit clinical sepsis, while 50 participants (33.3%) were diagnosed with clinical sepsis.

The mean total count of the study participants taken from cord blood was 10971 with standard deviation 2699.176. The mean Absolute neutrophil count of the study participants taken from cord blood was 6599 with standard deviation 3162.092. The mean platelet count of the study participants taken from cord blood was 2.06 lakhs with standard deviation .574. The mean CRP value of the study participants taken from cord blood was 3.4 with standard deviation 1.0444.

The mean total count of the study participants taken from neonatal blood was 10998 with standard deviation 2705.289. The mean Absolute neutrophil count of the study participants taken from neonatal blood was 6823 with standard deviation 3357.853. The mean platelet coun t of the study participants taken from neonatal blood was 2.11 lakhs with standard deviation 0. 468. The mean CRP value of the study participants taken from neonatal blood was 3.9 with standard deviation 1.9547.

Out of 150 participants, 23(15.3%) had positive I/T ratio in cord blood and 14(9.3%) had positive I/T ratio in neonatal blood.

Table 1 shows association between cord blood parameters with clinical sepsis (n = 150)

Among the study participants who had sepsis, the mean cord blood total count was 11458. And the mean Cord blood total count among the study participants who had no sepsis was 10728. And this mean difference was not statistically significant according to independent T- test (p = 0.119).

Among the study participants who had sepsis, the mean cord blood absolute neutrophil count was 7743.72. And the mean Cord blood absolute neutrophil count among the study participants who had no sepsis was 6026.50. And this mean difference was statistically significant according to independent T-test (p = 0.003).

Among the study participants who had sepsis, the mean cord blood platelet count was 2.11 lakhs. And the mean Cord blood platelet count among the study participants who had no sepsis was

2.04 lakhs. And this mean difference was not statistically significant according to independent T-test (p = 0.480).

Table 2 shows association between neonatal blood parameters with clinical sepsis (n = 150)

Among the study participants who had sepsis, the mean Neonatal blood Hb was 11.9 grams. And the mean Neonatal blood Hb among the study participants who had no sepsis was 11.6 grams. And this mean difference was not statistically significant according to independent T- test (p = 0.086).
Among the study participants who had sepsis, the mean Neonatal blood total count was 11458. And the mean Neonatal blood total count among the study participants who had no sepsis was 10728. And this mean difference was not statistically significant according to independent T-test (p = 0.119).
Among the study participants who had sepsis, the mean Neonatal blood absolute neutrophil count was 7350.52. And the mean Neonatal blood absolute neutrophil count among the study participants who had no sepsis was 6560.20. And this mean difference was not statistically significant according to independent T-test (p = 0.175).
Among the study participants who had sepsis, the mean Neonatal blood platelet count was 2.23 lakhs. And the mean Neonatal blood platelet count among the study participants who had no sepsis was 2.05 lakhs. And this mean difference was not statistically significant according to independent T-test (p = 0.080).

Out of 150 participants, 43(29%) showed positive culture findings in neonatal blood culture and sensitivity. Out of 43, the prevalence of Staph aureus infection was 26(90%). similarly, the prevalence of enterococci and pseudomonas infection was 9(21%) and 8(19%) respectively.

Table 3,4,5,6 shows correlation between cord blood parameters and neonatal blood parameters (n= 150**)**

For all the blood parameters, both the cord blood and neonatal blood had positive correlation with statistical significance (P < 0.0001). Thus, the reliability of cord blood is almost equal to neonatal blood.

Table 1 Association between cord blood parameters with clinical sepsis (n = 150)

Cord blood	Clinical sepsis	N	Mean	Std. Deviation	Mean difference	P - Value
Hb	No	100	11.636	1.146	- 0.3260	0.086
	Yes	50	11.962	0.962		

Totalcount	No	100	10728.00	2531.4	- 730.000	0.119
	Yes	50	11458.00	2973.97		
Absolute neutrophil count	No	100	6026.50	2822.39	- 1717.22	0.003
	Yes	50	7743.72	3507.73		
Plateletcount	No	100	2.04	0.553	- 0.071	0.480
	Yes	50	2.11	0.618		

Table 2 Association between neonatal blood parameters with clinical sepsis (n = 150)

Neonatal blood	Clinical sepsis	N	Mean	Std. Deviation	Mean Difference	P - Value
Hb	No	100	12.734	1.302	- 0.520	0.012
	Yes	50	13.254	0.903		
Total count	No	100	10728	2531.4	- 810.0	0.084
	Yes	50	11538	2976.7		
Absolute neutrophil count	No	100	6560.20	3304.0	- 790.32	0.175

	Yes	50	7350.52	3435.7		
Platelet count	No	100	2.05	0.450	- 0.171	0.080
	Yes	50	2.23	0.486		

Table 3 Correlation between cord blood parameters and neonatal blood parameters (n= **150)**

		Neonatal blood Total count
Cord blood Total count	Pearson Correlation	0.999
	P-Value	< 0.0001
	N	150

Table 4 Correlation between cord blood parameters and neonatal blood parameters (n= **150)**

		Neonatal blood absolute neutrophil count
Cord blood absolute neutrophil count	Pearson Correlation	0.951
	P-Value	< 0.0001
	N	150

Table 5 Correlation between cord blood parameters and neonatal blood parameters (n= **150)**

		Neonatal blood platelet count
Cord blood platelet	Pearson Correlation	0.911

count	P-Value	< 0.0001
	N	150

Table 6 Correlation between cord blood parameters and neonatal blood parameters (n= **150)**

		Neonatal blood CRP
Cord blood CRP	Pearson Correlation	0.911
	P-Value	< 0.0001
	N	150

DISCUSSION:

The gold standard for diagnosing newborn sepsis is the growth of microorganisms in a PVBC sample. The amount of blood that was drawn plays a significant role in the success of the blood culture. PVBC has a lot of issues, including trouble getting enough blood collected. Antibiotic administration before to blood sample collection is frequently the cause of PVBC not growing. Venipuncture of a neonate requires the use of healthcare professionals with elevated skill levels, and these highly skilled professionals must set aside a lot of time to collect a newborn blood sample.

Some scholars have researched UCBC collection for years. By employing UCBC in 150 patients, Pryles et al. described the effects of chorioamniotic infection on neonates in 1963.[7] In order to diagnose newborn sepsis, Albers and Tyler examined umbilical cultures in 1966.[8] Polin et al. reported using 200 UCBC for the diagnosis of newborn sepsis in 1981.[6] Hersonet al. employed 81 newborns placental surface blood from umbilical veins in their study and came to the conclusion that it was a valuable addition in newborns who were at risk for sepsis.[9]

113 newborns complete blood counts from cord blood and venous blood were compared for analysis in 2005 by Hansen et al. In sepsis examinations of asymptomatic term newborns, cord blood was found to be a safe alternative to infant blood.[5]

As part of a universal screening for early-onset sepsis based on maternal risk factors, Costakos et al. substituted umbilical cord blood collection with traditional blood culture collection in 2006. They reported on the process of collecting UCBC and demonstrated that the method is reliable and less painful.[10]

Dierikx et al conducted a meta-analysis in 2022 to assess the diagnostic test accuracy (DTA) of umbilical cord blood culture (UCBC) for EOS. They concluded that UCBC has higher sensitivity and comparable specificity for clinical EOS and might be considered as diagnostic test for EOS.

In the current study, the prevalence of term newborns with risk factors for neonatal sepsis was 28.7%. Staph aureus infections were prevalent in 60.4 percent of them. Like enterococci, pseudomonas infection had a prevalence of 20.9 and 18.6%, respectively. This was consistent

with the incidence of positive blood cultures reported in investigations by Joshi et al. and Mamta et al., where they were found to be 25% and 18%, respectively.[12,13]

Similar findings were made in the study by Pankaj et al, in which 23.3 percent of infants suspected of having early-onset sepsis had positive blood cultures. The organisms that caused early-onset sepsis, however, revealed different results. These included Klebsiella pneumonia (27.1%), Staphylococcus hemolyticus (21.4%), Acinetobacter (12.8%), E. coli (8.5%), and Staphylococcus aureus (8.5 percent).

17.8% of the infants in the study by Kalathia et al. (8 out of 45) had positive blood culture results. Escherichia coli (18.18 percent), Pseudomonas (45 percent, 5 out of 11), Acinetobacter (27.27 percent, 3 out of 11), and Klebsiella (18.18 percent, 2 out of 11) were the organisms cultivated in UCBC (9 percent, 1 out of 11).[14]

Marco et al in 2022 did a meta-analysis and concluded that evaluation of markers in the umbilical cord for the diagnosis of early-onset neonatal sepsis, could contribute to a more assertive therapy for the neonate and anticipate sepsis screening. Since the cost is less and technically easier, C-reactive protein is recommended for routine use.[15]

CONCLUSION:

In this study, umbilical cord blood proved valuable in identifying bacterial sepsis in high-risk newborns, enhancing the diagnostic process. Haematological indicators like TLC, ANC, and CRP, crucial in diagnosing newborn sepsis, exhibited similarity in umbilical and cord blood, suggesting resource-efficient diagnostic potential in limited settings. 28.7% of newborns exhibited risk factors for neonatal sepsis, with Staph aureus infections prevailing in 60.4% of cases followed by Pseudomonas and enterococci infections. Clinical sepsis was identified in 33% of participants.

Early detection of early-onset sepsis relies on a vigilant approach, particularly in neonates with significant perinatal risk factors. High index of suspicion, updating procedures and antibiotic policies is vital to mitigate risks associated with neonatal early-onset sepsis, aligning with the evolving microbiological landscape.

LIMITATION AND RECOMMENDATION:

Limitation: Conducting umbilical cord blood culture in conjunction with peripheral venous blood culture can provide a more thorough assessment of the diagnostic efficacy of umbilical blood. Novelmarkers of sepsis including Sr. Procalcitonin, CD-64, IL-6, Sr.Amyloid A can be used to compare umbilical and venous blood. Expanding the number of samples can enhance statistical power and generalizability of the findings.

Recommendation: Further studies including novel markers like Sr. Procalcitonin, CD-64, IL-6, Sr.Amyloid A with more sample size will be useful to maximize the diagnostic potential of umbilical cord blood.

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