Section: Pediatrics

Original Research Article

A STUDY ON CORRELATION OF UMBILICAL CORD BLOOD CULTURE WITH SEPSIS SCREEN IN DIAGNOSIS OF EARLY ONSET NEONATAL SEPSIS IN HIGH-RISK NEONATES

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ABSTRACT

Background: Neonates constitute the nation's foundation, and mothers are its pillars, and no one can afford to neglect their needs and rights. The neonatal period is considered the most important age group at all times, as newborns are most susceptible to diseases and death. Neonatal sepsis is the most common cause of neonatal mortality. This study aimed to evaluate specificity and sensitivity of the umbilical cord blood culture with comparison to sepsis screen in peripheral venous blood culture positive early onset neonatal sepsis

Materials and Methods: Study setting and population This study was conducted in the Neonatal Intensive Care Unit, Department of Pediatrics, Alluri Sita Ramaraju Academy of Medical Sciences (ASRAM), ELURU, ANDHRA PRADESH. Study design: Prospective analytical study conducted from December 2020 to May 2022. Study period: 18 months. Sample size: 158.

Results: Diagnostic efficiency of UCBC with PVBC: UCBC had 17.86% sensitivity, 84.62% specificity, PPV of 20%, NPV of 82.71%, and diagnostic accuracy of 72.78% in our study. Diagnostic efficiency of Sepsis Screen with PVBC: Sepsis screen had 100% sensitivity, 61.54% specificity, PPV 35.9%, NPV 100%, and diagnostic accuracy of 68.35% in our study.

Conclusion: Traditionally, sepsis screen has high sensitivity and high negative predictive values and is being used as screening test in suspecting EONS. From our study Umbilical cord blood culture has significant correlation with sepsis screen. So Umbilical cord culture can be used as a supportive investigation along with sepsis screen to diagnose early onset neonatal sepsis.

Keywords: Neonatal sepsis, Umbilical cord culture, sepsis screen

INTRODUCTION

Neonates constitute the nation's foundation, and mothers are its pillars, and no one can afford to neglect their needs and rights. The neonatal period is considered the most important age group at all times, as newborns are most susceptible to diseases and death. Neonatal sepsis is the most common cause of neonatal mortality.[1] It accounts for nearly 3 million neonatal deaths per year and an estimated neonatal mortality rate of 23.9 per 1000 live births globally. About 2% of foetuses are infected in utero and up to 10% of infants have infections in the 1st month of life.[2] The incidence of neonatal sepsis according to the data from National Neonatal Perinatal Database is 30 per 1000 live births. The NNPD network, comprising of 18 tertiary care neonatal units across India found sepsis to be one of the commonest causes of neonatal mortality contributing to 19% of all neonatal deaths.[3] Neonatal sepsis is a clinical syndrome characterized by non-specific signs and symptoms caused by invasion by pathogens.[1,2] Early-onset neonatal sepsis (EOS), occurring within 72 hours of birth, has high fatality rates, making prompt diagnosis essential.[3-7] Neonatal survivors of sepsis can have severe neurologic sequelae due to central nervous system (CNS) infection as well as from secondary hypoxemia resulting from septic shock, persistent pulmonary hypertension, and severe parenchymal lung disease.[8,9] Sepsis-related

mortality is largely preventable with prevention of sepsis itself, timely recognition, rational antimicrobial therapy, and aggressive supportive care. Sepsis is deemed culture-proven if confirmed by microbial growth on blood cultures. Identification of organisms responsible for neonatal sepsis is important, as decision on antibiotics stewardship and duration of treatment are dependent on it.[10-12] Current diagnostic standards often rely on peripheral venous blood culture as a gold standard test for diagnosis of neonatal sepsis. Drawbacks of traditional peripheral venous blood collection are inadequate sample collection, painful and invasive, need for skilled expertise of proper blood collection techniques, and delayed results, which made to thought of another, better alternative. The umbilical cord is a potential site for the collection of blood culture at the time of delivery in a high-risk neonate but is less commonly used.[4-11] offers advantages such as ease, minimal discomfort, and sufficient sample volume.[4]

Aim

This study aimed to evaluate the specificity and sensitivity of the umbilical cord blood culture with comparison to sepsis screening in peripheral venous blood culture-positive early-onset neonatal sepsis.

MATERIALS AND METHODS

Study setting and population: This study was conducted in the Neonatal Intensive Care Unit, Department of Pediatrics, Alluri Sita Ramaraju Academy of Medical Sciences (ASRAM), ELURU, ANDHRA PRADESH.

Study Design: Prospective analytical study conducted from December 2020 to May 2022

Study period: 18 months.

Sample size: 158

Inclusion Criteria

- All newborns are at high risk for early-onset neonatal sepsis.
- Neonates with 2 or more perinatal risk factors for early onset neonatal sepsis, such as
- Maternal pyrexia (>380°C) 2 weeks prior to delivery
- Preterm gestation (<37 wks)
- Unclean vaginal examination (>3)
- Maternal Urinary Tract Infections
- Chorioamnionitis
- Prolonged labor (>24 hours) both stages
- Prolonged rupture of membranes (> 18 hours)
- Foul smelling liquor
- Meconium-stained liquor
- Low birth weight (<2500 grams)
- Birth asphyxia and difficult resuscitation.

Exclusion Criteria

Neonates with life-threatening congenital anomalies.

Ethics and Consent: Ethical approval was obtained from the Institutional Ethics Committee, ASRAM, ELURU. Written informed consent was obtained from parents or guardians.

Data collection and blood sampling: A detailed antenatal history regarding risk factors for sepsis, as mentioned in the inclusion criteria, was assessed and documented. Blood has been collected from the umbilical cord for culture after clamping at the placental side and the neonate side. The cord was wiped with 70% isopropyl alcohol using sterile technique using a sterile 22G needle and syringe, and 1 ml of blood was drawn from the umbilical vein. The needle was replaced on the syringe with a new sterile needle, the culture bottle top was cleaned with alcohol, and blood was injected into the aerobic blood culture bottle and later sent to the laboratory. Peripheral venous blood samples for sepsis screens (total leukocyte count, absolute neutrophil count, IT ratio, C-reactive protein, and micro ESR) and cultures from all the neonates included were collected between 6 and 12 hours of birth. Blood was collected in conventional blood culture bottles (McCartney) containing BHI (brain heart infusion) broth and was processed in a BOD (biological oxygen demand) incubator at 370°C for 7 days. Routine subcultures were taken between 48 and 72 hours and again on the 5th and 7th days on all apparently negative culture bottles. Subcultures were done on blood agar and MacConkey agar at 370°C for 24-48 hrs. If any growth was observed, then organisms were identified biochemically, and antibiotic sensitivity was done as per the standard laboratory procedure. If the baby was unstable, they were shifted to the NICU for evaluation and treatment. If the baby was stable, baby was shifted to the mother's side. Babies were followed for 72 hours for clinical sepsis.

The results of sepsis screen, UCB culture, and PVB culture are collected and analysed

Statistical analysis: The information collected regarding all selected neonates was recorded in the master chart. data analysis was done with use of computerising Microsoft Excel and SPSS 22.0 were using this software frequently. Chi square test was applied and p values were also calculated wherever necessary. A P value less than 0.05 is taken as statistically significant. Sensitivity and specificity, and positive and negative predictive values were also calculated.

RESULTS

Demographic data Mode of Delivery: The majority of neonates, 101 (69%), were delivered via lower-segment cesarean section (LSCS). while 48 (30.4%) were delivered by normal vaginal delivery. Only 1 (0.6%) delivery was an instrumental delivery.

Gestational age Most neonates, 57 (36.1%), were delivered BETWEEN 34 AND 36 weeks of gestation. Among others, 42 neonates (26.6%) were born at 37 to 38 weeks of gestation, 34 neonates (21.5%) were born at >38 weeks of gestation, and the remaining 25 neonates (15.8%) were born at <32 weeks of gestation.

Birth Weight: The largest group of neonates, 73 (46.2%), had birth weights >2,500 grams. This was followed by 43 (27.2%) neonates weighing between 2000 and 2500 grams and 29 (18.4%) weighing 1500 to 1999 grams. remaining 13 (8.2%) neonates weighing less than 1500 grams

Gender Female neonates constituted a majority, with 87 (55.2%), while males accounted for 7771 (44.9%)

PVBC results: On PVBC, it was found that 17.7% of the study subjects were positive for the culture. 82.3% of the study population were negative for PVBC.

UCBC results: It was found that 15.8% of the study subjects were positive for the culture. 82.3% of the study population were negative for UCBC.

Sepsis screen results: It was found that 49.4% of the study subjects were positive for sepsis screening. 50.6% of the study population was negative for the sepsis screen.

Diagnostic efficiency of UCBC with PVBC: UCBC had 17.86% sensitivity, 84.62% specificity, PPV of 20%, NPV of 82.71%, and diagnostic accuracy of 72.78% in our study.

Diagnostic efficiency of Sepsis Screen with PVBC: Sepsis screen had 100% sensitivity, 61.54% specificity, PPV 35.9%, NPV 100%, and diagnostic accuracy of 68.35% in our study.

Diagnostic efficiency of UCBC with Sepsis Screen: UCBC had 24.36% of Sensitivity, 92.5% of Specificity, PPV 76%, NPV 55.6%, and Diagnostic accuracy of 58.86%and significant correlation with sepsis screen with a p-value less than 0.05 in our study.

Table 1: Diagnostic efficiency of UCBC compared to PVBC

UCBC	PVBC		
	Positive	**Negative**	**Total**
Positive	5	20	25
Negative	23	110	133
Total	28	130	158

Sensitivity: 17.86%. PPV- 20%.
Specificity- 84.62%. NPV82.71%

Table 2: Diagnostic efficiency of Sepsis screen compared to PVBC

Sepsis screen	PVBC		
	Positive	**Negative**	**Total**
Positive	28	50	78
Negative	0	80	80
	28	130	158

Sensitivity 100%. PPV 35.9%
Specificity 61.54% NPV 100%

Table 3: Diagnostic efficiency of UCBC compared to SEPSIS SCREEN

UCBC	SEPSIS SCREEN		
	Positive	**Negative**	**Total**
Positive	19	6	25
Negative	59	74	133
	78	80	158

UCBC had 24.36% of Sensitivity, 92.5% of Specificity, PPV 76%, NPV 55.6% and Diagnostic accuracy of 58.86% and significant correlation with sepsis screen with a p-value of 0.003.

DISCUSSION

Comparison of positive rates of peripheral venous blood culture in different studies on PVBC found that 17.7% of the study subjects were positive for the culture. 82.3% of the study population was negative for PVBC. The culture positivity in our study was 17.7%, which closely follows the studies done by Kalathia et al,[12] 2013 Gujarat and Chacko and Sohi et al,[13] with positive peripheral venous blood culture rate of 17.8% and 20.6%respectively.

Comparison of positive rates of umbilical cord blood culture in different studies on UCBC, it was found that 15.8% of the study subjects were positive for the culture. 82.3% of the study population was negative for UCBC. The positive rate as detected on umbilical cord blood culture among 158 neonates was 15.8% in the present study and is comparable with studies done by Herson et al,[14] Fos et al,[15] and Kalathai et al,[12] with positive rate of 20%, 43%, 24.44% respectively. Umbilical cord blood culture was taken from babies with perinatal risk factors. Umbilical cord blood culture positivity differs from studies done by Albers and Tyler (9%),[16] Polin et al,[17] (3%) as these studies were screening studies without any focus on risk factors.

Comparison of umbilical cord blood culture and peripheral venous blood culture in different studies in the present study 15.8% of umbilical cord blood culture have tested positive on PVBC and is comparable with the study Polin et al, with 17.7% positivity of peripheral venous blood culture among umbilical cord blood cultures.[18-23] The reason for not having 100% positivity on peripheral venous blood culture may have been a lesser volume of sample

blood when taken for culture in case of PVBC when compared to umbilical cord blood culture, as the culture positivity depends on volume of innoculum.
Several people have studied collecting UCBC in the past. Pryles et al,[18] researchers, reported the effects of Using UCBC to treat chorioamniotic infection in infants 150 people. Albers and Tyler 34 investigated umbilical Neonatal sepsis diagnosis using cultures. 1981 saw Polin et al,[17] reported using UCBC for neonatal disease diagnosis. by gathering 200 UCBC, sepsis. In their research, Herson et al,[14] utilised blood taken from an umbilical vein taken from placental surface from 81 new-borns, determining that it was a helpful addition for infants who are susceptible to sepsis. The total blood counts of 113 neonates were analysed using matched findings from cord blood and venous blood in 2005 by Hansen et al.[19] The study's conclusion was that cord blood might be used in place of new-born blood in sepsis assessments of term, asymptomatic infants. As part of universal screening for early-onset sepsis based on maternal risk factors, Costakos et al,[20] substituted umbilical cord blood collection with traditional blood culture collection in 2006. They reported on the process of collecting UCBC and demonstrated the method is reliable and less painful. UCBCs of 30 new-born samples were collected by Fos et al,[15] in 2010, who came to the conclusion that UCBC represents a more practical and straightforward method of diagnosing neonatal sepsis. Based on a positive PVBC, sepsis was declared to be present, Sepsis rates of 20.6% in neonates at high risk and 0.5% in new-borns at low risk have been reported by Chacko and Sohi 32. 17.7% of babies in our study had a positive PVBC. According to Fos et al,[15] 28% of high-risk neonates get sepsis. According to Pryles et al,[18] newborn with a high risk of sepsis had a sepsis rate of 31%. Comparison of diagnostic parameters of Umbilical cord blood culture in comparison to peripheral venous blood culture in different studies When we compared the diagnostic efficiency of UCBC with PVBC, UCBC had 17.86% of Sensitivity, 84.62% of Specificity, PPV 20%, NPV 82.71 and Diagnostic accuracy of 72.78% in our study. A significant correlation was found between the peripheral venous blood culture and umbilical cord blood culture in our study with sensitivity, specificity, PPV, NPV of 17.8%, 84.6%, 20%, 82.7% respectively. Some of the diagnostic parameters which were specificity and NPV of umbilical cord blood culture in the present study is comparable with studies done by Kalathia et al,[12] and J. Meena et al,[21] are as shown in the above table. It was comparable with Anudhakar et al,[22] in this study UCBC was shown to have a sensitivity of 75% and a specificity of 85.92% when compared to PVBC. The relative positive and negative predictive values were 23.08% and 98.39%. Shows diagnostic parameters of umbilical cord blood culture and sepsis screen in relation PVBC When we compared the diagnostic efficiency of SS with PVBC, SS had 100% of Sensitivity, 61.54% of Specificity, PPV 35.9%, NPV 100% and Diagnostic accuracy of 68.35% in our study. Which was comparable to Anudhakar et al,[22] in this study The sensitivity and specificity of the sepsis screen were determined to be 100% and 71.83%, respectively, in contrast to PVBC. 16.67% and 100%, respectively, were the positive and negative predictive values. In jain. P, et al,[23] Similarly, a significant association was found between PVBC and sepsis screen. 95.2% sensitivity with 86% negative predictive value. The specificity was 68.4% and the positive predictive value was 66. A significant correlation was found between the peripheral venous blood culture and umbilical cord blood culture in our study with sensitivity, specificity, PPV, NPV of 17.8%, 84.6%, 20%, 82.7% respectively.
In our study we compared the diagnostic efficiency of UCBC with Sepsis Screen, UCBC had 24.36% of Sensitivity, 92.5% of Specificity, PPV 76%, NPV55.6% and Diagnostic accuracy of 58.86% and significant correlation with sepsis screen with p value 0.003 was seen. Which was mostly comparable with Jain P et al,[13] this study found a significant association between UCBC and sepsis screen. The sensitivity was 96.15%, the specificity was 72.9%, the positive predictive value was 55.55%, and the negative predictive value was 98.18%.

CONCLUSION

Traditionally, sepsis screen has high sensitivity and high negative predictive values and is being used as screening test in suspecting EONS. From our study Umbilical cord blood culture has significant correlation with sepsis screen. So Umbilical cord culture can be used as a supportive investigation along with sepsis screen to diagnose early onset neonatal sepsis.

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