Original Article

Prospective study of umbilical cord blood culture for early diagnosis of early onset neonatal sepsis

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Background: Neonatal sepsis is clinical syndrome characterized by sign and symptoms of infections with or without accompanying bacteremia in the 1st month of life. Painless and non invasive manipulation, avoids iatrogenic stress source to vulnerable newborn, which could cause deterioration and possible anemia. As early onset neonatal sepsis (EONS) being a leading cause of neonatal mortality, the study of umbilical cord blood culture (UCBC) as painless and technically easily feasible alternative for early diagnosis of EONS would be helpful. **Materials and Methods:** This is a hospital-based prospective cross-sectional study conducted over 1 year from November 2019 to October 2020. 80 neonates delivered in hospital, having risk factors for neonatal sepsis were included in this study. UCBC samples and peripheral venous samples were samples were sent consecutively. **Results:** Cord blood culture came more positive (18.8%) as compared to peripheral venous culture (13.3%). Risk factor analysis showed that prolonged rupture of membrane was seen in 28 out of 80 neonates. Among which 8 came out to be positive with a $P < 0.05$ means there was statistical significant. **Summary:** When contrasted to peripheral venous blood culture, UCBC is a useful technique for increasing the etiological identification of bacterial sepsis in high-risk neonates and is more accurate. Our study shows that 15 out of 80 neonates (18.8%) had a positive blood culture as compared to 11 out 80 neonates (13.2) showed positive peripheral blood culture. *Staphylococcus auerus* (6.3%) was most common organism whereas for the cases of *Acinetobacter*, *Escherichia coli*, *Enterobacter*, *Enterococcus*, and *Pseudomonas* had been showed up as 2.5% each and for *Klebseilla* 1.3% been observed.

KEY WORDS: Early onset neonatal sepsis, late onset sepsis, umbilical cord blood culture, peripheral venous blood culture, premature rupture of memebrane

INTRODUCTION

Neonatal sepsis is the most common cause of neonatal mortality in developing countries. It accounts for nearly 3 million neonatal deaths per year and an estimated neonatal mortality rate of 23.9 per 1000 live birth globally.[1] Nearly, 2% of fetuses are infected in utero and up to10% of infants have infections in the first life of month.[2]

Neonatal sepsis is described as a systemic infection which occurs in infants at <28 days of life and is an important cause of morbidity and mortality of newborns.[3] Neonatal sepsis is classified into 2 types, that is, early onset neonatal sepsis (EONS) and Late neonatal sepsis. EONS has been defined based on the age of onset, with bacteremia or bacterial meningitis occurring at <72 h in infants whereas late onset sepsis is sepsis occurring

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after 72 h.[4] Maternal risk factors leading to early onset sepsis include premature rupture of memebrane (PROM), H/O fever within 2 week prior to delivery, meconium stained amniotic fluid, foul smelling liquor and instrumental delivery. Apart from obstetric factors, prematurity and low birth weight are associated with increased bacterial infection rate. Early recognition of sepsis is required for prompt initiation of antibiotics to prevent neonatal morbidity and mortality.[3]

It is extremely important to make an early diagnosis of the neonatal sepsis for prompt institution of antimicrobial therapy at the right time, which improves the outcome. The newborns specially the preterms are more prone to serious premature infections because mostly the signs of these infections may be absent or subtle and hard to detect.[4] Thus, fatal septicemia may occur with little warning. Hence, the timely diagnosis of sepsis in neonates is critical as the illness can be rapidly progressive and in some instances fatal.[4]

MATERIALS AND METHODS

The present study titled "prospective study of umbilical cord blood culture for early diagnosis of early onset neonatal sepsis" was undertaken in Neonatal Intensive care unit in Department of Paediatrics in collaboration with department of Microbiology of Rohilkhand Medical College and Hospital, Bareilly, UP, over a period of 1 year from 1st November 2019 to 31st October 2020. 80 neonates were included. Babies who were delivered at RMCH as/to:
1. Term babies with AGA
2. Mother who had fever with evidence of a bacterial infection within 2 week before delivery[1]
3. Mother who had foul smelling liquor[1]
4. Mother who had rupture of membrane >24 h[1]
5. Mother who had single unclean or >3 sterile vaginal examination during labor[1]
6. Prolonged labor (sum of first and second stage of labor ≥24 h)[1]
7. Perinatal asphyxia(APGAR<4 at 1 min).[1]

Babies who had 2 or more than 2 above mentioned inclusion criteria or H/o foul smelling liquor were included in this study.

Procedure

This cross-sectional study was conducted in Department of Paediatrics in collaboration with the Department of Microbiology, Rohilkhand Medical College, Bareilly.

After obtaining consent, and before the delivery, the forth coming newborn was assigned as per inclusion and exclusion criteria so that blood from umbilical cord was collected with prior preparation, that is, cutting the cord after clamping of cord at placental side and infant side with each pair of clamp. Umbilical Cord was wiped with 70% isopropyl alcohol using sterile technique. Using a sterile 22 gauge needle and syringe, approximately 3.5–4 ml blood was drawn into syringe from umbilical vein. 1.5 ml blood would be injected in BD Bactec

peads plus/F Medium blood culture bottle and was sent to microbiology laboratory for automated culture by BACTEC FX 40 system. High risk infants with 2 or more than 2 risk factors positive sepsis screen parameters were given antibiotics empirically which were later modified as per culture results and their sensitivity.

Newborns were admitted either in NICU or to mother side and prospectively followed till their stay in hospital. Their peripheral blood samples (2 ml) for sepsis screen were collected in EDTA vials. Then, peripheral venous blood culture (PVBC) sample (1.5 ml) was sent in BACTEC blood culture bottle. Baseline characteristics such as sex maturity, weight risk factor for sepsis. Umbilical cord blood culture (UCBC), sepsis screen reports, and PVBC were recorded.

RESULTS

The distribution of gender, where the highest percentage of positivity of blood culture, was observed in male group than in female group. The mean weight been observed as 2816.25 grams. The mean of APGAR score at 1 min observed as 7.89. The mean gestational age been observed as 38.124 as we have included only term babies in our study.

The cord culture and peripheral blood culture were compared where out of 80 neonates 15 (18.8%) came positive for cord blood while 11 (13.8%) came positive for peripheral venous blood [Table 1].

The below Table 2 shows that the distribution of organism *Staphylococcus auerus* (6.3%) was most common organism Where as for the cases of *Acinetobacter*, *Escherichia coli*, *Enterobacter*, *Enterococcus,* and *Pseudomonas* been showed up as 2.5% each and for *Klebsiella* 1.3% been observed.

Table 1: The comparison of cord CUL versus PBC

	PBC		Cord CUL.	
	Frequency	**Percent**	**Frequency**	**Percent**
Negative	69	86.3	65	81.3
Positive	11	13.8	15	18.8
Total	80	100.0	80	100.0

Table 2: The distribution of organism

	Frequency	**Percent**
Acinetobacter	2	2.5
Escherichia coli	2	2.5
Enterobacter	2	2.5
Enterococcus	2	2.5
Klebsiella	1	1.3
Pseudomonas	2	2.5
Staphylococcus auerus	4	6.3
None present	65	80.0
Total	80	100.0

In our study, we compared various risk factors (such as foul smelling liquor, maternal fever, labor>24 h, per vaginum examination >3 times, and premature rupture of membrane >18 h) with UCBC positivity. Among which PROM >18 showed statistical significant relationship with cord blood culture.

The Table 3 shows the distribution of neonates who had history of premature rupture of membrane (PROM) >18 h where only 28 out 80 neonates had history of PROM >18 h. The neonates who had history of PROM >18 h had more positivity of cord blood cultures, and data show statistical significance ($P < 0.05$).

DISCUSSION

Sepsis is the most frequent infectious diseases in the newborn phase, and it continues to be a significant cause of morbidity and death in the neonatal period despite significant advances in neonatology over the past decades has been observed in the study conducted by Chacko and Sohi.[5]

In our study, out of 15 cord blood positive, 10 were male neonates, while 5 were female neonates. A study done by Meena *et al.*[6] also showed male preponderance. One of the theories describes that the Factor regulating immunoglobulin synthesis is located mainly on X chromosome thus males are more prone to sepsis. The study done by Meena *et al.* also included neonates of mean gestational age of 36.6 ± 0.7 weeks, whereas mean gestational age in our study is 38+7 weeks.

Culture positivity has been reported more frequently in neonates with multiple risk factors. In our study, the comparison of cord culture and peripheral blood culture has been done where out of 80 neonates 15 (18.8%) came positive for cord blood while 11 (13.8%) came positive for peripheral venous blood. In our study, the distribution of organism were also done where *Staphylococcus aureus* (6.3%) was most predominanat followed by *Acinetobacter*, *E. coli Enterobacter*, *Enterococcus* and *Pseudomonas* been showed up as 2.5% each and for *Klebseilla* 1.3% been observed. Though bacteriological predomaninance varies in all other hospital setup many other studies like done by Deepa *et al.*[7] showed Staphylococcus as the common organism. In study done by Fos *et al.*,[8] we found that gram-positive and gram-negative microbes accounted for 50% of the total organisms in their investigation, which was conducted in 2010. *Klebsiella* (32.5%), *S. aureus* (13.6%), *E. coli* (10.6), *Pseudomonas* (5.6%), and *Acinetobacter* (5.6%) were the organisms that caused sepsis in intramural infants, according to the National

neonatal perinatal database of India in 2002–2003 (2.7%) has been shown in the study of Deorari *et al.*

Premature rupture of membrane (PROM) is defined as rupture of amniotic membrane 1 h before onset of labor. Prolonged rupture of membrane is considered when there was further delay more than 18 h after rupture of membrane. Risk factor analysis showed that prolonged rupture of membrane was seen in 28 out of 80 neonates. Among which 8 came out to be positive with a $P < 0.05$ means there was statistical significance.

Mandot and Gandhi[9] concluded that UCBC is 100% sensitive and 98.8percent specific. In their study, Organisms grown on cultures were *E. coli*, klebsiella, *Pseudomonas* and *Acinetobacter*.

Study done by Deepa *et al.* compared 70 neonates among which 30 neonates showed bacterial growth with *S. aureus* in 25.8% and streptococci in 19.35 neonates. They also came to a conclusion that cord blood culturing with total WBC count test are more reliable in early diagnosis of the neonatal sepsis. They also suggest that the profile of organisms in their study depicts organisms that could be presumed to acquire during regular hospital checkups during pregnancy. Recent studies by Meena *et al.*[10] studied high risk neonates, subgroups based on their weights. About 17 out of 80 neonates (21.2%) had positive bacterial growth in UCBC as compared to 15 out of 80 neonates showed peripheral blood culture. In their study, 10 newborns had similar bacteriological profile in both umbilical and peripheral blood culture. Those neonates who had more than two risk factors had more positivity in UCBC and NBC, that is, 60%, respectively. Umbilical cord is an easily accessible source of adequate neonatal blood. Since cord blood is collected at the time of delivery, it avoids the effect of antibiotics, which has to be given prophylactically in early post-partum.[11] In comparison to venous blood, a smaller volume of cord blood has been found to yield a positive result, especially in case of EONS associated with intrauterine sepsis.[12] UCBC provides a painless alternative to traditional PVBC to overcome these drawbacks of PVBC.

CONCLUSION

Here, we can conclude:
- When contrasted to PVBC, UCBC is a useful technique for increasing the etiological identification of bacterial sepsis in high-risk neonates and is more accurate
- Our study shows that 15 out of 80 neonates (18.8%) had a positive blood culture as compared to 11 out 80 neonates (13.2) showed positive peripheral blood culture
- *S. auerus* (6.3%) was most common organism whereas for the cases of *Acinetobacter*, *E. coli*, *Enterobacter*, *Enterococcus* and *Pseudomonas* been showed up as 2.5% each and for *Klebseilla* 1.3% been observed.

Table 3: The relation between prom>18 and cord culture

	Cord cul.		Total	Chi-square value	*P*-value
	Negative	Positive			
PROM>18					
n	45	7	52	2.72	<0.05
y	20	8	28		
Total	65	15	80		

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