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Original Research Article

Umbilical cord blood culture versus peripheral venous blood culture in early onset neonatal sepsis

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ABSTRACT

Background: Neonatal sepsis is a major cause of neonatal morbidity and mortality. Blood culture and sensitivity is gold standard for the diagnosis of neonatal sepsis. Low sensitivity of blood culture especially in newborn is due to small volume of blood sample collected from neonates and antibiotics given before sampling. The aim was to evaluate the use of umbilical cord blood culture in the diagnosis of early onset neonatal sepsis as compared to Peripheral vein blood culture.
Methods: Eighty neonates with two or more risk factors for early onset neonatal sepsis were included in the study. Blood samples were collected from umbilical cord and peripheral vein for culture. Sepsis screen was done to corroborate the diagnosis of neonatal sepsis.
Results: Sepsis screen was positive in twenty three babies. Among these four had grown organism on Umbilical cord blood culture only. While two babies had both positive, Umbilical cord bloods culture and peripheral vein blood culture. Organisms grown on culture were *E.Coli, Pseudomonas, Klebsiella* and *Acinetobacter.*
Conclusions: Umbilical cord blood culture is simple and convenient method for the diagnosis of early onset neonatal sepsis compared to peripheral venous blood culture. Organisms grown are comparable to peripheral venous blood culture sample.

Keywords: Neonatal sepsis, Peripheral vein blood culture, Sepsis Screen, Umbilical cord blood culture

INTRODUCTION

Neonatal sepsis is the most common cause of neonatal mortality. It account for nearly 3 million neonatal deaths per year and an estimated neonatal mortality rate of 23. 9 per 1000 live birth globally.[1] 2% of foetuses are infected in utero and upto 10% of infants have infections in the 1st month of life.[2]

Neonatal sepsis is define as a blood stream infection which develops within 28 days after birth.[3] Early onset neonatal sepsis is defined as infection within the 1st three days of life and is associated with transmission of organism from birth canal. The mortality associated with early onset neonatal sepsis is higher than that of late onset sepsis.[4] Early recognition of sepsis is required for prompt initiation of antibiotics to prevent neonatal morbidity and mortality.[5] Gold standard for the diagnosis of neonatal sepsis is blood culture collected from peripheral veins.[5,6] Variable and low sensitivity of peripheral vein blood culture is mainly due to in adequate sample volume and administration of antibiotics prior to sample collection.[7-9] Umbilical cord blood can be collected for blood culture for diagnosing early onset neonatal sepsis. Umbilical cord blood collection procedure for culture is painless and it ensures adequate volume of blood for culture with less contamination.[10-15]

There are less published data to support umbilical cord blood culture routine use in early onset neonatal sepsis.

This study was carried out to evaluate the utility of umbilical cord blood culture in neonates at high risk for early onset neonatal sepsis in comparison to peripheral vein blood culture.

METHODS

A prospective, analytical study was done at tertiary care teaching hospital in North India with approval of institutional ethics committee. Study subjects were newborns delivered in labour room/operation theatre over a period of 8 months (November 2015 to June 2016). Informed consent in written format was obtained from parents. Newborns with birth weight >1500gms and maturity >28 weeks attended by pediatric resident at the time of delivery were included. These newborns were at risk of developing sepsis based on presence of 2 or more risk factors for early onset neonatal sepsis.

These risk factors were prematurity (<35 completed weeks), prolonged rupture of membrane (>18 hours), premature rupture of membrane, prolonged labour (> 24 hours), foul smelling liquor, maternal fever (>100.4 f), frequent vaginal examinations (>3) and birth asphyxia.[3,10,16]

Neonates without any risk factors and babies with congenital metabolic disorder were excluded from the study.

Umbilical cord blood, peripheral vein blood and sample for sepsis screen were collected from 80 newborns with presence of 2 or more risk factors for neonatal sepsis.

Umbilical cord blood was collected at birth. Post-delivery the umbilical cord was clamped on both placental and umbilical end and was cut between each pair of clamps. The placental end was wiped with isopropyl alcohol and with a 22 gauge syringe, 4ml blood was collected from the placental end of umbilical artery or vein. 2 ml blood was immediately transferred to BACTEC culture vial (Becton, Dickinson & company, USA) for culture and remaining blood was used for estimating C-reactive protein using commercial latex agglutination kit.16 Similarly peripheral venous blood culture and test for sepsis screen were done within 24 hours post-partum. High risk neonates with 2 or more positive sepsis screen parameters were given antibiotics empirically which were later modified as per culture results.

Newborns were evaluated for any clinical feature of early onset neonatal sepsis such as lethargy, hypotonia, fever, tachycardia, abdominal distension, retractions, grunting, increase aspirates, hypotension, delayed capillary refill, hypotension, pallor, hepatomegaly, apnea, abnormal skin colour, bradycardia, sclerema, shock and features of disseminated intravascular coagulation.

Newborn were admitted and prospectively followed till their hospital stay. Baseline characteristics such as sex, maturity, weight, risk factor for sepsis, sepsis screen reports, Umbilical cord blood culture and Peripheral vein blood culture reports were recorded. Umbilical cord blood culture as a diagnostic test was evaluated by using Medcale online statistical calculator for sensitivity and specificity.

RESULTS

Eighty neonates (forty males and thirty five females) with two or more risk factor for early onset neonatal sepsis were included and evaluated for sepsis by umbilical cord blood culture, umbilical cord blood C-reactive protein, peripheral venous blood culture and sepsis screen.

Table 1: Baseline characteristics of subjects.

Details	Observed
Number	80
Sex ratio	35: 45 (1:1.28)
Weight in Kg (mean)	2.35 Kg
Maturity in weeks (mean)	35 weeks

Baseline characteristics of subjects was studied. Mean gestational age was 35 weeks and female: male ratio was 1:1.28 (Table 1).

Table 2: Risk factor distribution.

Risk factors	Sepsis screen positive	Sepsis screen negative	Total
Prematurity	6	4	10
Low birth weight	8	5	13
Birth asphyxia	2	0	2
Prolonged rupture of membrane	12	5	17
Premature rupture of membrane	8	4	12
Maternal fever	1	0	1

Distribution of risk factors in sepsis screen positive and sepsis screen negative group. Cord C-reactive protein was negative in all (Table 2).

Sepsis screen was positive in twenty three babies. Among these six babies had grown organism on blood culture (four on umbilical cord blood culture only and two on Umbilical cord blood culture and peripheral vein blood culture both). Organism grown on culture were *E. Coli*, *Klebsiella*, *Pseudomonas* and *Acinetobacter*. The mean time for positive results in BACTEC was 10 hours for Umbilical cord blood culture and 16 hours in peripheral vein blood culture. Umbilical cord blood culture is 100% sensitive and 98.8% specific (Table 3).

Table 3: Sensitivity and specificity of umbilical cord blood culture and peripheral vein blood culture.

	Sensitivity	Specificity
Umbilical cord blood culture	100%	74.87%
Sepsis Screen	100%	73.08%

Table 4: Results of diagnostic tests for neonatal sepsis.

	Sepsis Screen	Umbilical cord blood culture	Peripheral vein blood culture
Positive	23	6	2
Negative	57	74	78

Twenty three babies were sepsis screen positive, six were umbilical cord blood culture positive and two were peripheral vein blood culture positive as shown in Table 4.

DISCUSSION

Growth of organism in blood culture sample is the gold standard for the diagnosis of neonatal sepsis.[17] However blood culture positivity usually accounts for a smaller proportion of clinically suspected and sepsis screen positive neonatal sepsis cases.[16,18] Volume of blood sample collected for the blood culture is an important factor for positive results. More than 1ml of blood is required for optimum recovery of pathogenic organism from blood. It is difficult to obtain 1ml blood from preterm and sick neonates.[8-10] Empirical antibiotics therapy is started on suspicion of sepsis, consequently reduces the chance of recovery of causative organism on culture.

Premature and prolonged rupture of membrane, low birth weight, prematurity, birth asphyxia and maternal fever are the risk factors observed and have been found to be associated with a higher risk of developing early onset neonatal sepsis and positive sepsis screen. Prolonged rupture of membrane was seen in twelve out of twenty three cases with positive sepsis screen. Male had a slightly higher incidence of positive sepsis screen.

Umbilical cord blood culture for diagnosing early onset neonatal sepsis is studied by many researchers. In 1963, Pryles et al reported effect of chorioamniotic infection on newborns by using umbilical cord blood culture in 150 babies.[11] In 1966, Albers and Tyler studied umbilical cultures for diagnosis of neonatal sepsis.[12] In 1981, Polin et al reported use of umbilical cord blood culture for diagnosis of neonatal sepsis by collecting 200 samples.[7] In their study Herson et al used blood collected from umbilical vein from 81 newborns and concluded it to be an useful tool for diagnosis of early onset neonatal sepsis.[14] In 2006, Costakos et al has submitted conventional blood culture collection with umbilical cord blood sample as part of universal screening of early onset neonatal sepsis based on maternal risk factors and reported about the Umbilical cord blood culture as reliable and less painful.[19] In 2010, Fos et al, had collected umbilical cord blood culture samples of 30 newborns and concluded that it is easier method of diagnosing Early onset neonatal sepsis.[20]

In our study, 7.5% newborns had positive umbilical cord blood culture. In a study conducted by Kalathia et al, umbilical cord blood culture was reported as a useful method to increase etiological diagnosis of blood stream infection in high risk neonates. In comparison to peripheral vein blood culture (which recovers 8 bacterial isolates), umbilical cord blood culture recovered 11 isolates and had a sensitivity of 80% and specificity of 91.4%.[23] In our study 6 babies had positive umbilical cord blood culture and only 2 had positive peripheral vein blood culture. The reason could be lower volume of blood obtained for culture in peripheral vein blood culture in comparison to Umbilical cord blood culture. This may also explain the shorter mean time to get positive results for Umbilical cord blood culture in Bactec. Chacks et al and Pyrles et al have reported sepsis rate of 20.6% to 31% in neonates with high risk of early onset neonatal sepsis. Albers et al had 9% and Polin et al had 3% of positive umbilical cord blood culture in their screening studies without any focus on risk factors.

Gram negative organisms were predominant organisms in blood culture. According to national perinatal database of India of 2002-03, organism causing sepsis in intramural babies were *Klebseilla* (32.5%), *Staphylococcus aureus* (13.6%), *E.coli* (10.6%), *Pseudomonas* (5.6%) and *Acinetobacter* (2.7%).[6,21] However recent studies from India showed similar organism profile as shown in our study. A study by Bhat el at showed 90.8% organism were gram negative and commonest organism were *Pseudomonas* (33.2%), *Klebseilla* (31.2%), *Acinetobacter* (14.4%) and *E. Coli* (4.4%).[22]

The limitation of this study is small sample size. Multicentric studies should be conducted to improve knowledge in Umbilical cord blood culture and thereby reduce the mortality among these high risk group babies.

CONCLUSION

Umbilical cord blood culture is a good method to increase etiological diagnosis of bacterial sepsis in high risk neonates as compared to peripheral venous blood culture. However, its potential in replacing peripheral venous blood culture needs to be evaluated in large multicentric trails.

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