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Comparison of CSF culture yield in BACTEC culture method versus conventional method in neonates with suspected meningitis.

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Abstract

Aims: To compare the Cerebrospinal Fluid (CSF) culture yield in BACTEC culture method *vs.* **conventional method in neonates with suspected meningitis.**

Methods: Neonates with clinical indication of lumbar puncture were included in the study. CSF samples from these neonates were analyzed by both BACTEC method and conventional method. The yield and time required for isolation was noted in both the groups. Results were analyzed by standard statistical methods.

Results: Out of 163 CSF samples processed in both BACTEC and conventional method, BACTEC method had a marginally higher yield as compared to conventional method and was statistically significant 7(4.29%) *vs.* **4(2.45%), p=0.001. The time for isolation of organisms was shorter in BACTEC method compared to conventional method (1.8 days** *vs.* **4.3 days).**

Conclusion: Culture of CSF in neonates by BACTEC method marginally increases the yield and time for isolation without much clinical significance.

Keywords: Cerebrospinal fluid, Neonatal meningitis, CSF culture, BACTEC culture.

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Introduction

Neonatal meningitis is one of the devastating form of infection in neonates with high mortality and poor long term neurological sequelae [1,2]. Accurate diagnosis of meningitis in neonates is challenging due to many diagnostic difficulties. One such challenge is interpretation of protein and sugar values, especially in preterm neonates due to increased permeability of blood brain barrier [3]. Currently, gold standard for diagnosis of neonatal meningitis is culture of Cerebrospinal Fluid (CSF) [4] and no other investigation apart from culture can reliably exclude meningitis in neonate [3]. However yield of culture is very low due to use of antibiotics and low volume of CSF taken for analysis. Many adult and paediatric studies have demonstrated the utility of BACTEC culture method for increasing the yield of sterile body fluids including CSF. Most of these studies have demonstrated increased yield when CSF is inoculated in BACTEC bottles. There are no clinical studies in neonates which have evaluated this aspect. Hence this study was planned to evaluate the yield of CSF in BACTEC culture method versus conventional method in neonates undergoing lumbar puncture.

Patients and Methods

This was a prospective observational study conducted in a level III neonatal unit of a tertiary care pediatric hospital in South India. All neonates with clinical indication for lumbar puncture were assessed for eligibility. Inclusion criteria for the study included all of the following: Gestational age between 32 to 42 weeks and weight more than 1250 grams, age less than 28 days and clinical indication of lumbar puncture. Neonates who were moribund with life expectancy less than 24 hours, major life threatening congenital malformations, spinal abnormalities and contraindications for lumbar puncture like thrombocytopenia (platelets <30000 mm^3) and INR>1.5 were excluded from the study. The study was approved by the institutional ethics committee and informed consent was obtained from all the parents.

All neonates who met all the inclusion criteria and none of the exclusion criteria were included in the study. These neonates underwent lumbar puncture as per unit protocol. Approximately 0.5 ml of initial CSF was drawn into a sterile syringe and inoculated into BACTEC bottle after cleaning the hub of BACTEC bottle with alcohol swab. Remaining CSF was collected in sterile vials for rest of the investigations including

cytology, sugar, protein, gram stain and culture by conventional method. BACTEC Microbial Detection Systems and culture bottles provide both a microbial detection system and a culture media with suitable nutritional and environmental conditions for organisms which might be present in the test sample. For conventional culture method the CSF samples were inoculated onto conventional media consisting of blood agar plate, a chocolate agar plate, MacConkey agar plate and thioglycolate broth.

CSF specimens were analyzed by standard culture methods and antibiotic susceptibility testing was done by Vitek-2 method. Clinical, demographic and baseline data of all the neonates was recorded in a predesigned proforma. The pattern of organisms, antibiogram and time for isolation were also recorded. In this study meningitis was defined as per criteria laid by the following criteria. For term neonates cells >8 cells/mm^3 or protein >120 mg/dl or glucose <20 mg/dl. In preterm neonates cells >10 cells/mm^3 or protein >170 mg/dl or glucose <24 mg/dl (Figure 1).

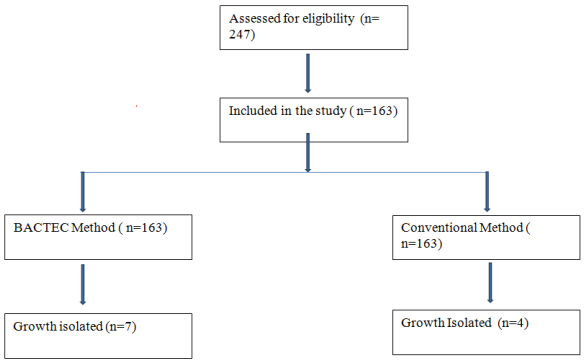

Figure 1. Flow diagram.

CSF culture yield in conventional method and BACTEC method was considered as primary outcome. The time required for isolation of organisms and contamination rate in both the methods were considered as secondary outcomes.

Sample size was calculated based on the positivity rate in conventional method of CSF culture. Data from our own institute showed a positivity rate of 3.4%. In order to compare between two methods with 80% power and 5% level of significance, the total sample size required was 163 in each group.

Statistical Analysis

Patient information was collected in a predesigned proforma. Data entry and analysis were done using SPSS version 18. The standard statistical tests were applied. Mean (SD) were used for continuous variables.

Paired data was analysed using student 't' test and proportions were analysed using chi square test. The results were considered significant at 5% level of significance ($p<0.05$).

Results

A total of 247 neonates were assessed for eligibility of which 84 neonates did not meet inclusion criteria for various reasons. A total of 163 neonates were included in the final analysis. The baseline demographic, clinical and laboratory characteristics is depicted in Table 1.

Parameter	Value
Age	
<3 days#	42(25.8%)
3 to 28 days#	121(74.2%)
Male#	108(66.3%)
Term#	119(73%)
Preterm#	44(27%)
Fever#	27(16.6%)
Lethargy#	76 (46.6%)
Vomiting#	10(6.1%)
Altered sensorium#	37(22.7%)
Normal#	13(8%)
Weight (kg)*	2.39 ± 0.71
Length (cm)*	46.87 ± 5.07
OFC (cm)*	32.33 ± 2.84
Day of LP*	14.97 ± 8.14

Total leukocyte count (per mm^3)*	14871± 8646
Hemoglobin (g/dl)*	14.31 ± 3.27
Platelet count (per mm^3)*	229242 ± 179295
Positive blood culture#	59 (36%)

Table 1. Baseline characteristics. *: Mean(SD), #: n(%).

In BACTEC method a total of 7 (4.2%) organisms were isolated as compared to 4 (2.4%) in conventional method (Table 2).

BACTEC method	Conventional method		Total	P-value
	Growth	No growth		
Growth	3	4	7	0.001
No growth	1	155	156	
Total	4	159	163	

Table 2. Organisms isolated in BACTEC and conventional method.

There were 2(1.2%) and 3(1.8%) contaminants in BACTEC and conventional method respectively. The average time for isolation was 51.4 hours in BACTEC group as compared to 96 hours in conventional group (Table 3).

Time (hrs)	BACTEC method	Conventional method
24	1	0
48	4	0
72	2	1
96	0	2
120	0	1
Average	51.4 hrs	96 hrs

Table 3. Time of isolation of organism in BACTEC vs. conventional method.

Blood culture was positive in 56 (36%) neonates out of 163 neonates. Out of 163 neonates, 55 neonates were diagnosed as meningitis, in which 7 neonates were positive in BACTEC method and 4 in conventional method. CSF culture by BACTEC method had a sensitivity of 75%, specificity 97%, positive predictive value of 46% and negative predictive value of 99%.

Discussion

The gold standard for diagnosis of neonatal meningitis is culture of CSF. Other CSF parameters including biochemical parameters and markers, either alone or in combination, cannot reliably exclude meningitis. Since the baseline yield of CSF by conventional culture methods is very low, a possibility of increasing the yield of CSF by culture in BACTEC method was explored in this study. Neonatal meningitis is a serious clinical condition with high mortality and morbidity [4]. The use of BACTEC culture system for culture of body fluids has been explored in many studies and has shown to improve the yield and time required for isolation as compared to conventional methods [5,6].

In a study by Akcam et al. BACTEC system was superior to traditional methods for isolation of organisms from body fluids and the highest yield was from cerebrospinal fluid as compared to other body fluids [7]. In a large analysis of 2,545 adult CSF samples by Young et al., BacT/Alert FAN method was superior to conventional method for culture of CSF samples. The positivity rate was 7.2% as compared to 3.1% in conventional method [8]. In our study even though there was a marginally increased yield in BACTEC method with statistically significant result (4.2% *vs.* 2.4%, $p<0.01$), it was not clinically significant to change the current practice of CSF analysis. There were only 4 samples which tested positive in BACTEC method which was negative in conventional method. Even in the neonates who were treated as meningitis based on other biochemical parameters, there was no increase in yield in BACTEC method. The possible reasons of low yield in our study could be due to prior administration of antibiotics, low

volume sent for analysis, probability of small inoculum of organisms [6].

Conclusion

The uniqueness of our study lies in the fact that it is the only study to the best of our knowledge which has evaluated this aspect in neonates. Our study is not without limitations. The volume of CSF used was less as compared to adult studies which might have an impact on low yield in our study. The use of prior antibiotics probably also had a role in low yield in BACTEC. In conclusion, culture of CSF neonates by BACTEC method marginally increases the yield without much clinical significance. The use of this method in neonates who have not received prior antibiotics and use of larger volume CSF in BACTEC method can be explored in large prospective studies.

References

1. Heath PT, Nik Yusoff NK, Baker CJ. Neonatal meningitis. Arch Dis Child Fetal Neonatal Ed. 2003; 88(3): 173–8.
2. Krebs VLJ, Costa GAM. Clinical outcome of neonatal bacterial meningitis according to birth weight. Arq Neuropsiquiatr 2007; 65: 1149–53.
3. Garges HP. Neonatal Meningitis: What is the correlation among cerebrospinal fluid cultures, blood cultures, and cerebrospinal fluid parameters? Pediatrics 2006; 117: 1094–100.
4. Gordon SM, Srinivasan L, Harris MC. Neonatal meningitis: Overcoming challenges in diagnosis, prognosis, and treatment with Omics. Front Pediatr 2017; 5: 1–10.
5. Çetin ES, Kaya S, Demirci M, et al. Comparison of the BACTEC blood culture system versus conventional methods for culture of normally sterile body fluids. Adv Ther 2007; 24: 1271–7.
6. Simor AE, Scythes K, Meaney H, et al. Evaluation of the BacT/Alert® microbial detection system with FAN aerobic and FAN anaerobic bottles for culturing normally sterile body fluids other than blood. Diagn Microbiol Infect Dis 2000; 37: 5–9.
7. Akcam FZ, Yayli G, Uskun E, et al. Evaluation of the BACTEC microbial detection system for culturing miscellaneous sterile body fluids. Res Microbiol 2006; 157: 433–6.
8. Yoo IY, Chun S, Song DJ, et al. Comparison of BacT/Alert FAN and FAN plus bottles with conventional medium for culturing cerebrospinal fluid. J Clin Microbiol 2016; 54: 2837–40.

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