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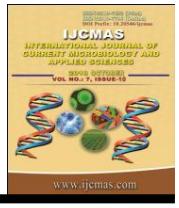

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Utility of BACTEC Blood Culture System versus Conventional Blood Culture Method for Detection of Bacteriaemia in Pediatric Patients

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A B S T R A C T

Blood stream infection is one of the major causes of mortality and morbidity of pediatric patients. Early detection of etiological agents and initiation of appropriate antibiotic therapy is utmost important for better prognosis and survival of such patients. BACTEC 9050 culture method is more sensitive than conventional blood culture method for detection of infection in respect to culture positivity rate and early detection.

Introduction

Bacteremia is one of the very important causes of infant and child mortality. Prompt diagnosis of the causative microorganisms and timely appropriate antibiotic treatment provided without further delay is the mainline management of such patients.

If not treated in time, it may lead to fatal outcome, such as, involvement of several organs and ultimately death (Alizadeh, 2016).

Detection of negative blood culture first time and on re test are also important to rule out several microbial blood stream infections. According to some researchers, about 90% of all blood culture is negative (Oren, 2006; Peter *et al*., 2008). It also shortens the hospital stay. Negative blood culture probably rules out bacterial or fungal blood infection (Aronson *et al*., 1987).

Aims and Objectives

Aim of this study is to identify the etiological agents of blood- stream infection of patients, admitted in pediatric ward in a tertiary care rural hospital of central Uttar Pradesh using BACTEC 9050 and conventional methods.

We also compared the advantage and disadvantage of the two types of blood culture methods used for this study, such as, conventional and Bactec methods.

Materials and Methods

A prospective, cross – sectional study was conducted in the microbiology department. Institutional ethical clearance was obtained for that.

This study was undertaken to find out utility of BACTEC system for detection of bacteriaemia in pediatric patients admitted in the hospital and to compare the result of this method with conventional method. The study area was a tertiary care rural hospital situated in central Uttar Pradesh and study period was seven months. We processed 129blood samples for culture during that study period, obtained from indoor pediatric patients.

Blood samples from those patients were processed in the microbiology laboratory of the same hospital. Blood samples were taken for both methods at the same time. No charge was imposed on patients for BACTEC method. All associated information including age, sex, hospital stay, clinical diagnosis, antibiotic use and day of blood collection for blood culture were noted down.

For blood culture by automated BACTEC system, BD BACTEC^{TM} Ped Plus$^{TM/F}$ culture vials (having soybean – casein digest broth with resin), were used. These bottles were obtained from Becton, Dickinson Company. The inoculated vials were placed in the BD BACTEC 9050 fluorescent series instrument (obtained from Becton, Dickinson Company) for incubation and monitoring following manufacturers instructions (Paisley JW *et al*., 1994). The BACTEC machine cannot identify the causative microorganism in blood. Therefore, subculture was done from the positive culture vial on MacConkey's and blood agar media to isolate and identify the etiological agents as per standard protocols (Collee *et al*., 2008). Antibiotic sensitivity test of isolates were done on Mueller Hinton agar. All the media, biochemicals and antibiotic disc for this work were obtained from Hi Media Pvt Ltd, India.

In conventional method, blood samples (0.5 – 5mL) sent to microbiology department in blood culture bottle containing brain heart infusion broth (20 mL).

Culture and antibiotic sensitivity test were done following standard protocols (Collee, 2008; CLSI, 2011; CLSI, 2013).

Results and Discussion

In 7 months study period, we processed 129 blood samples for culture, from indoor pediatric patients. Among these samples, 23(17.9%) showed growth by conventional method. Average time of detection was 24 hours. Out of 23 culture-positive samples of patients, 20(86.9%) were not having empirical antibiotic therapy, whereas, 3(13.0%) were receiving the same.

On the other hand, using automated blood culture system, number of culture positivity were 31(24.1%), average time of detection being 18 hours. Out of 31 culture positive specimens, 24(77.4%) patients were not receiving antibiotic and 7(22.5%), with empirical antibiotic treatment.

Table 1: Blood culture showed 23(17.9%) positivity and 106(82.2%) negativity by conventional method and 31(24.1%) positivity and 98(75.9%) negativity by BACTEC 9050. Average time of detection of microbial growth was 24 hours in conventional method and 18 hours in BACTEC system for the same.

Table 2: In conventional blood culture method, 86.9% samples from patients without antibiotics were culture positive and only 13.0% with antibiotic therapy were culture positive. In automated system, 77.4% samples

from patients without prior antibiotic therapy and 22.5% with antibiotic therapy were culture positive.

The aim of this study was to compare the utility of BACTEC 9050 culture system with the conventional blood culture of indoor patients of pediatrics department in a tertiary care teaching hospital.

BACTEC 9050 is a fully automated blood culture system. It recognizes increase in CO_2 concentration produced by multiplication of microbes. For this purpose, there is presence of fluorescent sensor at the bottom of blood culture vials (Surase *et al*., 2016).

In our study, 31 (24.1%) samples out of 129total samples showed growth of microorganisms by BACTEC system. On the other hand, 23 (17.9%) out of 129 samples showed growth by conventional method. This result is similar to the studies done by several other workers (Maham *et al*., 2012; Udayan *et al*., 2014; Celin *et al*., 2007; Surase *et al*., 2016; Weinstein, 1996).

The culture positive 23 samples by conventional blood culture positive were also showed positivity by automated method. No isolate detected only by conventional method and not by BACTEC system. Similar observation was made by Emel *et al*., (2007).

Table.1 Comparison of culture positivity and negativity and average time of detection of Conventional and BACTEC method of Blood culture (n=129)

Blood culture method	Culture Positivity	Culture negativity	Time of detection (Average)
Conventional	23(17.9%)	106 (82.2%)	24 hours
BACTEC	31(24.1%)	98 (75.9%)	18 hours

Table.2 Comparison of isolates from clinical samples in relation to without empirical antibiotic treatment and with antibiotic treatment

Empirical antibiotic therapy	Conventional (n=23)	Bactec (n=31)
Without antibiotic	20(86.9%)	24(77.4%)
With antibiotic	3(13.0%)	7(22.5%)

We observed that 3 (13.0%) blood samples from patients with empirical antibiotic therapy were culture positive by conventional method. On the other hand, 7 (22.5%) showed growth on culture by BACTEC method in clinical samples with prior antibiotic treatment. Significant higher blood culture positivity by automated system might be due to its capability of neutralizing antibiotics from blood. In the blood culture vials of BACTEC system, provision of ion exchange and non- ionic adsorbent resin are present to remove the antibiotics of blood samples.

In contrast to our study, Alizadeh *et al*., (2016) and Chokephaibulkit (1999) found that, there was no significant difference between the two methods in term of positive blood culture, even in pediatric patients already having antibiotic therapy. Although they reported that time taken to achieve positive blood culture by BACTEC was much shorter than conventional method. There were other researchers who were in favour of use of BACTEC system for blood culture because of rapid diagnosis (Afjeiee *et al*., 2009; Kaur *et al*., 2014). They observed that BACTEC is

fairly reliable and time saving method, sensitivity being 100%, whereas; the sensitivity of conventional method was only 67.56%.

In our study, average time of growth of microorganisms is 24 hours in conventional system and 18 hours in automated system. The time taken to reveal a positive blood culture is very important. This is quite significant, because early recognition of bacteremia followed by initial management are essential for prevention of progression of condition to more severe form. But too many factors play a role for blood culture positivity, such as, distance between wards and the laboratory, transport system available, patient population served etc., which affect the value of comparisons of detection times reported at different sites (Peter *et al*., 2008).

Adrienne *et al*., (2014) also reported that early recognition of bacteremia followed by prompt initial management were essential for prevention of progression of the condition of the patient to more severe form. Early diagnosis also helped in preventing sepsis related disability and death.

In our study, one blood sample showed growth of aerobic spore bearer (contamination) on second subculture by conventional method, whereas sample from same patient, collected during same time for automated system was sterile. This may be because repeated subculture was done in conventional system. These manipulations may be the reason for contamination that was not required in BACTEC system and thereby, reducing the chance of contamination (Surase *et al*., 2016). However, they also reported in their research work, that out of 136 culture positive isolates from blood specimens, 12 contaminants were detected by BACTEC, whereas only 9 were detected by conventional method. According to Weinstein MP, 1996, two blood cultures should be sufficient to detect septicemia.

Aronson *et al*., (1987), discouraged single blood culture by conventional method, single blood cultures being insufficiently sensitive for detecting some bacteremia and fungemia,

While using this automated system, care should be taken to collect optimum volume of blood samples (1 – 3 mL), because optimum volume of blood can neutralize inhibitory effect of sodium polyanethol sulfonate (SPS) present in BD BACTEC PED PLUS/F culture vials and allow growth of SPS sensitive and fastidious organisms from blood samples. Adequate blood sample is also required to provide growth factor, such as, Nicotinamide adenine dinucleotide to certain Haemophilus species. Lin *et al*., (2013), reported that optimum blood volume obtained from patient was directly proportional to the growth of microorganisms in automated blood culture system. Some other researchers observed that, use of less than 1 ml of blood in neonates often shows false negative result. They found several plus point for automated blood culture system, such as, higher recovery of etiological microorganisms, fully automated, and easy method of operation. But at the same time they also reported about high implementation cost and requirement of continuous power supply (Dreyer, 2012).

Fully automated BACTEC system has many merits in term of recovery- time of growth of microorganisms even in patients having empirical antibiotic therapy. Therefore, this can be opted for that patient who can afford the expenses.

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