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TANAFFOS

Comparative Evaluation of Conventional and BACTEC Methods for Detection of Bacterial Infection

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Background: Infectious diseases are a leading cause of morbidity and mortality in developing countries. The aim of this study was to compare the results of blood culture employing the conventional and BACTEC methods for detection of bacterial infection in Taleghani Hospital, Tehran.

Materials and Methods: This was a descriptive study carried out for 3 months (March 2014-May 2014) on 272 inpatients. Their blood culture results were analyzed using the two methods (BACTEC and conventional).The results were analyzed using descriptive statistics (frequency, mean and standard deviation) and inferential tests (cross tab) via SPSS version 17 software.

Results: The results of 177 cases (94.1%) out of 271 studied subjects were true positive, 11 (5.8%) were false negative, 2 cases (3.15%) were false positive, and 11 cases (6.48%) were true negative. The sensitivity and specificity of the BACTEC test were 84.6 and 94.1, respectively, and the rate of positive blood cultures employing BACTEC method was equal to 100% (22.22) while in the conventional method, positive results were equal to 59.09% (22.13).

Conclusion: Both BACTEC and conventional methods have high validity. In order to evaluate the results of blood culture and infection control, experts can use either of these methods to study the results of bacterial blood culture.

Key words: BACTEC, Conventional, Hospital, Hospitalized patient

INTRODUCTION

Septicemia is one of the main causes of mortality in patients. Blood culture is the most common method of identifying systemic infections caused by bacteria. The infections caused by Gram-negative bacteria are not treated properly because of the unavailability of new methods for early detection (1). Moreover, infectious diseases are among the main causes of death in developing countries. If left untreated, bloodstream infections may lead to more dangerous infections, involving all organs and ultimately death. Spectrum of microorganisms that cause blood infection is different in various countries, cities, or treatment centers. But most Gram-negative bacteria play a more prominent role in this respect than Gram-positive bacteria in infections, and sepsis developed and reported by Gram-negative bacteria is increasing especially in Asian countries (2).

Among the various types of nosocomial infections, bloodstream infection is a very serious health problem in hospital wards globally (3). Despite recent advances in techniques such as polymerase chain reaction (PCR) and nucleic acid probe and other molecular techniques for microbiologic diagnosis, blood culture remains the most practical and most reliable method for detection of blood infections. Blood culture is the best method for detection of infection with a sensitivity of 35- 90%. It is fast, affordable, and precise (4). Blood culture is the gold standard for

identifying the causative factors of blood infection. Identification of bacteria and fungi by blood culture in patients with sepsis is essential for proper treatment and selection of appropriate antibiotics (5).

Bacterial infections are the major cause of infectious diseases and mortality all over the world (6). Accurate diagnosis will lead to appropriate treatment. In this regard, the role of medical diagnostic laboratories in hospitals is of particular importance. Among the major bacteria, *Escherichia coli* is a major cause of urinary tract infection, *Staphylococcus aureus* is the major cause of wound infection, and *Pseudomonas aeruginosa* plays a key role in nosocomial infections. Knowledge-based science in microbiology, adequate experience, employing the latest resources of microbiology, utilization of the latest World Health Organization protocols and standard reference laboratories are very important for accurate identification of bacteria. Standard and accurate diagnosis of bacteria and appropriate antibiogram and subsequent timely and effective treatment of diseases play an important role in public health promotion (7). Prompt identification of infection type enhances early efficient treatment. On the other hand, negative blood culture can decrease the length of hospitalization and hospital costs. It seems that technical problems or inappropriate storage conditions of microbes, may be responsible for a negative blood culture. Full automatic BACTEC method is superior to conventional methods in terms of speed and sensitivity (8). The conventional method includes two-week culture in order to enable slow growth of microorganisms and if needed, some microorganisms are cultured on specific media (4). This method is the easiest way of blood culture where fluid bottles of blood culture with a relative vacuum are utilized. The blood is transferred to the blood culture bottle in sterile conditions, it is turned upside down for a few minutes, a hole is created in its cover using a sterile needle and it is placed in an incubator. This medium is commonly used for the isolation of bacteria (9,10). If the glasses of automated blood culture system of BACTEC inform microbiologist when growth level is enough to reach a level that is identifiable by the device, then it is important for quick decision making for patients (11).

The aim of this study was to compare the capacity, efficacy, and safety percentage of BACTEC and conventional methods for isolation of bacteria from the blood of febrile patients. Due to the high cost of BACTEC method compared to the conventional method, the results of the present research can be used to choose the best method suitable for blood culture.

MATERIALS AND METHODS

The study population of the present study included patients admitted to Taleghani Hospital of Tehran. Two hundred and seventy two hospitalized patients who were admitted from March to May 2014 in 12 wards with respiratory infections and their blood culture was requested by the attending physicians by BACTEC method were selected.

Sampling was implemented for both methods at the same time. BACTEC method imposed no cost on patients. The characteristics of patients including gender, age, hospitalization period, diagnosis, smoking status, antibiotic use, and day of blood sampling were recorded after determining blood culture results for both the conventional and BACTEC methods.

In this descriptive study, data were analyzed using descriptive statistics (frequency, mean and standard deviation) for variables such as sex, ward, age and antibiotic use, and analytical methods (cross tab) of SPSS software version 17 were utilized to evaluate the interaction between blood culture results of BACTEC method.

RESULTS

One hundred and eighteen patients (43.2%) were males and 106 (38.8%) were females. There were 105 patients (38.5%) in the NICU, 35 (12.8%) patients in hematology, 34 (12.5%) in bone marrow transplantation, 27 patients (9.9%) in the gastroenterology ward, 22 patients (8.1%) in the intensive care unit, 15 patients (5.5%) in oncology, 7

patients (2.6%) in the department of vascular surgery, 6 patients (2.2%) in the orthopedic and endocrinology, 4 patients (1.5%) in the cardiac intensive care unit, 3 patients (1.1%) in nephrology and general surgery, 2 patients (0.7%) in women's surgery, and ear, nose and throat, and 1 (0.4%) in the cardiology ward.

Statistical analysis revealed that 231 (84.6%) patients consumed antibiotics. The frequency distribution of age in selected sample revealed that 75 patients (37.5%) were infants, 58 (28.9%) were less than 40 years, 46 patients (22.9%) were between 40-64 years, 22 patients (10.9%) were older than 65 years and, the age of 71 patients (26.4%) was unknown. One hundred and ninety nine culture samples (93%) were negative and 15 samples (7%) were positive using the conventional method.

The result of blood culture was negative in 222 samples (87.7%) and positive in 31 samples (12.3%) using the BACTEC method.

Finally, the compliance level of blood culture results in two methods including conventional and
BACTEC was calculated according to Table 1.

Based on the data presented in Table 1, the sensitivity, specificity, positive predictive value and negative predictive value were calculated for the BACTEC and the conventional method (Table 2).

Table 1. Blood culture results in the two methods

Conventional method	BACTEC method		Total
	-	+	
-	([17] TN) 177		188
+	([20] FN) 2		13
Total	22		201

Table 2. Sensitivity, specificity, positive predictive value and negative predictive value of BACTEC and the conventional method

Sensitivity	[TP/(TP+FN)]*100 84.6%
Specificity	[TN/(TN+FP)]*100 94.1%
Positive predictive value	[TP/(TP+FP)]*100 50%
Negative predictive value	[TN/(TN+FN)]*100 98.8%

DISCUSSION

The results of this study indicated that the rate of negative blood culture results utilizing the conventional (93%) and BACTEC method (87.7%) was in line with the results of Nolte et al. (8) and Gopi et al. (12). In this study, male to female ratio was 1.11:1 and this was due to the variety of patients admitted to different wards. This result was inconsistent with the results of Durmaz et al.; because in their study, male to female ratio was 1.99:1 due to their sample size and higher frequency of men exposed to airborne infection and the role of men as family breadwinners (13).

The highest rate of positive blood culture results was obtained using the BACTEC method, which was equal to 100% (22.22) compared with the conventional method (22.13, 59.09%). The difference between positive samples was observed in 9 (40.9%) cases in two methods which were identified using BACTEC method. The results of this study were consistent with the results of Nourbakhsh et al., which was implemented in Rasoul Akram Hospital. They implemented a cross-sectional study on children aged 1 month to 14 years hospitalized in pediatric ward with a sample size of 327 patients. Cultures were done simultaneously using both methods. They concluded that BACTEC method was significantly different when compared with the conventional method in 150 positive blood cultures. But significant differences were not observed between the two methods for separating Gram-positive and Gram-negative microorganisms. In terms of positive blood culture in patients who received antibiotics before the study, no significant difference was observed between the two methods. The average time of achieving positive results of blood culture using the BACTEC method was shorter than the conventional method (14). The findings of this study showed that there was no significant difference between the two methods of blood culture in detection of microorganisms in the group that had already received antibiotics. Antibiotic consumption has no effect on the growth of microorganisms. On the other hand, the results of Afjeiee et al. demonstrated that it

is better to use faster and more sensitive laboratory methods such as blood culture by BACTEC system in order to reduce psychological problems and costs related to hospitalization of children and that in the case of a negative blood culture, treatment can be carried out with greater certainty.

The results of this study were inconsistent with the results of the study carried out on 120 neonates with suspected sepsis in Mahdiye Hospital of Tehran. Nevertheless, in the adore-mentioned study, conventional and BACTEC methods were not compared at the same time (15).

The results of this study were not consistent with the results obtained by Kaur et al. In their study on 100 suspected cases of fever with unknown source, it was shown that sensitivity (100%) of BACTEC method was higher than the conventional method (67.56%) and they concluded that BACTEC method is a rapid and reliable method for detection of pathogens in blood culture (4).

CONCLUSION

Blood culture has been indentified as a simple, accessible method for identification of factors that cause blood infections. Moreover, blood culture has been utilized in several studies to investigate the prevalence of infections as well as assessment of the association between age, duration of hospitalization and the used procedures in intensive care units. Nevertheless, due to the high cost of automated systems compared to manual methods, blood culture is performed in most health care centers. These methods have the advantage of being cheap, readily available, and not requiring sophisticated and expensive devices. Both BACTEC and conventional methods have high validity. In order to evaluate the results of blood culture and infection control, experts can use either of these methods to study the results of bacterial blood culture.

Researchers have suggested that in order to compare the two methods of evaluation, type of isolated microorganisms from the blood using conventional and BACTEC methods should also be assessed in similar studies, and also the effect of antibiotic consumption should be studied using both methods.

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