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A Comparative Study of Conventional and Automated Culture System [BACTEC] For Detection of Bacterial Infection

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Original Research Article

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Abstract: Isolation of microorganisms is very important for accurate treatment and is one of the important concerns for clinical microbiologists. The accuracy and rapidity of treatment are critical for successful treatment. The present study was undertaken to find the time duration for detection of various microorganisms with BACTEC 9050 system. Methods: The present study was done on inpatients the Thumbay New Life Hospital, Chaderghat road, Hyderabad from the period of June 2016 to June 2017. Samples are drawn from the patient and injected directly into BACTEC 9050 culture vials. Positive cultures are immediately flagged by an indicator light on the front of the instrument and displayed on the monitor. When positive vials are identified, it is removed and isolated for identification of organisms. Results: Out of total 475 samples collected during this duration 315 samples were from male patients and 160 from female patients. Out of 315 male samples, 69 were found to have a positive culture in 69 (21.9%) samples. Similarly out of 160 samples from females 41(25.62%) were found to have a positive culture. The most common organism detected by BACTEC in positive cultures Enterobacteriaceae in 39 (35.45%) out of 110 samples Staphylococcus aureus in 21 (19.09%), Streptococcus spp in 15 (13.63%), Coagulase-Negative staphylococci in 13 (11.81%). The conventional method showed the growth only in 77 (16.21%) of the total 475 samples during the study period however the same samples in BACTEC showed 110 (23.15%) growth Average time to detection was highest in Cryptococcus spp in 78.9 hours, Corynebacterium spp 72.1 hours, Candida spp 65.5 hours. Least time to detection Enterobacteriaceae was 14.9 hours. Conclusion: it can be concluded that the BACTEC culture method is superior to the conventional method as it detects the presence of bacteria faster and it is not affected by patient's use of antibiotics and it is also economical. Hence BACTEC culture methods must be used whenever it is feasible.
Keywords: BACTEC, Conventional Method of culture, Bacterial Infection.

INTRODUCTION

Microorganisms may enter the blood during certain disease conditions. Microbial invasion of bloodstream can have serious immediate consequences including shock, multiple organ failure, disseminated intravascular coagulation (DIC) and death. The rapidity of detection of microorganisms is of prime importance for proper diagnosis and treatment of sepsis. Bacterial Sepsis constitutes one of the most serious infectious diseases in spite of advances in treatment and therefore the expeditious detection and identification of blood-borne bacterial pathogens is an important function of the diagnostic microbiology laboratory [1]. Based on the clinical condition of the patient, the physician determines what group is likely to be causing infection. Specific types of blood culture include Aerobic, Anaerobic and Fungal. Most of the blood culture tests for both aerobic and anaerobic microbes [2]. Blood cultures are performed using techniques ranging from manual to totally automated techniques [3]. In the manual method of blood culture, the blood sample obtained is added to 100 ml of a rich growth medium such as Brain Heart Infusion broth and incubated at 37 degree Celsius for 24 hours. The blood culture bottles are watched daily for signs of growth including cloudiness or a color change in the broth, gas bubbles or clumps of bacteria. When there is evidence of growth, the laboratory does subculture and antibiotic sensitivity tests. The delay in the final culture report remains one of the main drawbacks of Manual blood culture system [4]. The isolation of any significant microorganism from a blood culture is an occurrence that requires careful evaluation by the clinician, and prompt action is usually necessary. If the results of clinical microbiological analyses are to contribute in a meaningful way to the diagnosis and management of patients with bacteremia, they must be made available to the clinician in a relevant time frame [5]. Automated blood culture system is considered as one of the recent technical advances in blood cultures. Automated blood

culture is carried out by two fully automated systems known as BACTEC and VITEK. BACTEC 9000 series of blood culture instruments are designed for rapid detection of microorganisms in clinical specimens. It is also called Continuous monitoring blood culture systems because the instrument automatically monitors the bottles containing patient blood for evidence of microorganisms, usually every ten minutes. A positive reading indicates the presumptive presence of microorganisms in the vial [6]. An automated system that monitors culture bottles for microbial growth minimizes the time necessary to detect positive blood cultures. Another way to save time might be to inoculate an automated system for rapid identification and susceptibility testing directly from positive blood culture bottles [7]. With this background we in the present study tried to study the efficacy and time to detection of BACTEC 9050 in our group of patients.

MATERIALS AND METHODS

This study was done on Blood Culture samples obtained from all the admitted patients to various wards of Thumbay New Life Hospital, Chaderghat road, Hyderabad from the period of June 2016 to June 2017. Institutional Ethical committee permission for the study was obtained. All the samples were collected in vacutainer 10ml under sterile conditions. The vacuum in the vial will usually exceed 10 ml. The specimens were inoculated into BACTEC vials at the bedside. All the blood samples received in BACTEC plus Aerobic Blood Culture Bottles were immediately loaded into the BACTEC 9050 (Continuous Monitoring Automated Blood Culture System). The samples were continuously monitored for positivity. The Blood Culture Vials which had been flagged as positive were immediately followed up. The TTD (Time to Detection) for various organisms was charted out. The Positive Blood culture bottle was taken out of the BACTEC 9050 and kept upright. With the help of needle syringe, a drop of blood was aspirated, and a Gram Stain was made along with Subculture onto Mac-Conkey Agar and Blood Agar for 16-18 hours. When Gram's staining showed a single type of organism the broth was processed for biochemical reactions and antibiotic susceptibility as per standard protocol. Although many positive blood cultures will be detected in the first 24 hours after inoculation, ongoing vials must be still kept for several days to assure maximum recovery. With the BACTEC florescent series instrument, vials are typically held for 5-7 days before they are discarded as negative.

RESULTS

A total of 475 samples were collected from the patients and processed out of which 110 (23.15%) were found to have positive cultures. Out of total 475 samples, 315 samples were from male patients and 160 from female patients. Out of 315 male samples, 69 were found to have a positive culture in 69 (21.9%) samples. Similarly out of 160 samples from females 41(25.62%) were found to have a positive culture. Most of the samples were obtained from 41 to 51 years of age group with 124 samples out of which 35 (31.81%) were found to be positive and the next age group where positive samples were obtained were from below 20 years without of 62 total of 17 (27.41%) were found to be positive. Similarly, other age groups and positive culture and percentages are shown in table-1.

Table-1: Gender wise and age wise distribution of cases included in the study

Parameters	Total samples	Culture positive	Percentage
Gender			
Male	315	69	21.9
Female	160	41	25.62
Total	475	110	23.16
Age			
< 20	62	17	27.41
21 - 30	83	16	19.28
31 - 40	90	21	23.33
41 – 50	124	35	31.81
> 50	116	21	18.1
Total	475	110	23.15

The most common organism detected by BACTEC in positive cultures Enterobacteriaceae in 39 (35.45%) out of 110 samples Staphylococcus aureus in 21 (19.09%), Streptococcus spp in 15 (13.63%), coagulase-negative staphylococci in 13 (11.81%). Average time to detection was highest in Cryptococcus spp in 78.9 hours, Corynebacterium spp 72.1 hours, Candida spp 65.5 hours. Least time to detection Enterobacteriaceae was 14.9 hours shown in table 2.

Table-2: Average time to detection with BACTEC 9050

	No. of clinically significant samples	Average time to detection (hours) with BACTEC 9050
Staphylococcus aureus	21	18.2
Coagulase-negative staphylococci	13	21.5
Streptococcus spp	15	10.5
Corynebacterium spp	1	72.1
Enterococcus spp	11	15.5
Enterobacteriaceae	39	14.9
Other gram-negative bacteria	6	20.2
Candida spp	3	65.5
Cryptococcus spp	1	78.9

Table-3: comparison of time required for growth by conventional and BACTEC Methods

Time duration when growth detected	No of samples by the conventional method	No of samples by BACTEC method
< 12 hours	0	5
12 – 24	1	16
24 – 48	17	54
48 – 72	29	29
72 – 96	30	6
> 96	0	0
Total number of samples	77 (16.21%)	110 (23.15%)

DISCUSSION

The rapidity of identification and performing sensitivity test can lead to rapid therapy in appropriate directions which are of immense benefit clinically. Bloodstream infection is one of the most serious problems in all infectious diseases [8]. However the source of organisms may not be determined in up to one-third of bacteremia [9]. The entry of bacteria in the bloodstream may be due to surgeries related to the genito-urinary tract, bowel or dental surgeries. Bacteremia may occur during some infections such as typhoid fever, brucellosis, and meningococcal infection [10]. Despite recent developments, like nucleic acid probes, PCR, and other molecular techniques for microbiological diagnosis, blood cultures still remain the most practical and reliable method in the diagnosis of bloodstream infections. [11] Conventional methods of blood culture have been in use since decades. These methods use culture media like brain heart infusion broth, bile broth, tryptic soy broth, glucose broth etc [12, 13]. However the conventional methods is limited by fewer isolation rates and slower growth of microorganisms which be due to the presence of antibiotics in the patient's blood and these disadvantages have been overcome by culture systems like BACTEC BacT/Alert and Versatrek have been used widely with added advantages like higher isolation rate, faste6 detection, lesser contamination etc [14-16]. Commercially available instrumented blood culture methods were first introduced in 1970. BACTEC instrumented systems were the only products available in the US and these were initially equipped with radiometric instruments and media, followed in mid-1980 by non-radiometric instruments and media. BACTEC and BacT/Alert continuous monitoring devices are based on the utilization of carbohydrate substances in the culture media and subsequent production of CO_2 by growing microorganisms. In our study time to detection, it was observed that significant pathogens like Staphylococcus aureus, Enterococcus, took lesser time to detection than the less pathogenic organisms like Coagulase Negative Staphylococci. Fungi on an average yielded a slightly higher TTD than the rest of the microorganisms. Few of the isolates could not be identified conventionally to the Species level. In a study by PR Murray *et al.*, [17] comparing BACTEC 9050 and BACTEC 9240 found that BACTEC 9050 has significant advantages over the manual and older semiautonomous blood culture system. In the present study, the conventional method showed the growth only in 77 (16.21%) of the total 475 samples during the study period however the same samples in BACTEC showed 110 (23.15%) growth. One of the important advantages of BACTEC media is that it has resins incorporated in them these are helpful in neutralizing the used antibiotics which are present in the blood of patients, therefore, BACTEC media is able to offer better isolation than the conventional media. Earlier detection of bacteria is important as far patient management is concerned it helps in accurate treatment with the required antibiotics and minimizes the use of unnecessary antibiotics and the patient compliance and recovery is faster and overall the duration of stay in hospital is decreased and expenditure is reduced.

CONCLUSION

Within the limitations of the present study, it can be concluded that the BACTEC culture method is superior to the conventional method as it detects the presence of bacteria faster and it is not affected by

patient's use of antibiotics and it is also economical. Hence BACTEC culture methods must be used whenever it is feasible.

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REFERENCES

1. Forbes, B. A., Sahm, D. F., & Weissfeld, A. S. (2007). *Study guide for Bailey & Scott's diagnostic microbiology*. USA: Mosby.
2. Koneman, W. E., Allen, D. S., Janda, M. W., Schreckenberger, C. P., & Winn, C, W. (1992). Color Atlas and Text book of Diagnostic Microbiology. 4th ed. Philadelphia: J.B. Lippincott Company.
3. Tang, W., & Stratton, W. (2006). Advanced Techniques in Diagnostic Microbiology. Ist ed. U.S: Springer.
4. McFadden, F. J. (1989). Biochemical Tests for Identification of Medical bacteria. 3rd ed. Lippincott Williams & Wilkins.
5. Huang, A. H., Wu, J. J., Weng, Y. M., Ding, H. C., & Chang, T. C. (1998). Direct antimicrobial susceptibility testing of gram-negative bacilli in blood cultures by an electrochemical method. *Journal of clinical microbiology*, *36*(10), 2882-2886.
6. BD-BACTEC- TM 9240 Blood Culture System, User's Manual (1Ed) 445475.
7. Moore, D. F., Hamada, S. S., Marso, E. U. G. E. N. E., & Martin, W. J. (1981). Rapid identification and antimicrobial susceptibility testing of gram-negative bacilli from blood cultures by the AutoMicrobic system. *Journal of clinical microbiology*, *13*(5), 934-939.
8. Winn Jr, W. C., Allen, S. D., Janda, W. M., Koneman, E. W., Procop, G. W., Scheckenberger, P. C., & Woods, G. L. (2006). Color AtlasTextbook of Diagnosis Microbiology sixth edition.
9. Hughes, J. G., Vetter, E. A., Patel, R., Schleck, C. D., Harmsen, S., Turgeant, L. T., & Cockerill, F. R. (2001). Culture with BACTEC Peds Plus/F bottle compared with conventional methods for detection of bacteria in synovial fluid. *Journal of clinical microbiology*, *39*(12), 4468-4471.
10. Collee, G. J., Mackie, J. T., & Mc Cartney, E. J. (1996). Mackie & Mc Cartney Practical Medical Microbiology. 14th ed. New York: Churchil Livingstone.
11. Wilson, M. L., Weinstein, M. P., & Reller, L. B. (1994). Automated blood culture systems. *Clinics in laboratory medicine*, *14*(1), 149-169.
12. Collee, J. G., Fraser, A. G., Marimon, B. P., & Simmons, A. (2008). Mackie and McCartney practical medical microbiology.l4th ed. Dethi. Churchill Livingstone.
13. Koneman, E. W., Allen, S. D., Janda, W. M., Schreckenberger, P. C., & Winn, W. C. (1997). Diagnostic microbiology. *The nonfermentative gram-negative bacilli. Philedelphia: Lippincott-Raven Publishers*, 253-320.
14. Gopi, A., Ambarish, K., Shwethalatha, N., Shree, S., Ashwini, K., Arpita, S., & Debjani, C. (2011). Time to positivity of microorganisms with BACTEC 9050: an 18-month study among children of 28 days to 60 months in an South Indian tertiary hospital. l*ntemational Journal of Microbiological Research*, *2*(1), 12-17.
15. Çetin, E. S., Kaya, S., Demirci, M., & Aridogan, B. C. (2007). Comparison of the BACTEC blood culture system versus conventional methods for culture of normally sterile body fluids. *Advances in therapy*, *24*(6), 1271-1277.
16. Chokephaibulkit, K., Sitthitrai, P., Wanprapa, N., Chearskul, S., Srifuengfung, S., Pingwang, B., & Dhiraputra, C. (1999). Comparison of BACTEC automated blood culture system and conventional system in hospitalized pediatric patients. *Journal of the Medical Association of Thailand= Chotmaihet thangphaet*, *82*(10), 1011-1016.
17. Murray, P. R., Hollick, G. E., Jerris, R. C., & Wilson, M. L. (1998). Multicenter comparison of BACTEC 9050 and BACTEC 9240 blood culture systems. *Journal of clinical microbiology*, *36*(6), 1601-1603.