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Comparative study of manual conventional blood cultures versus automated blood culture system in cases of septicemia

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ABSTRACT

Introduction: Blood cultures are a proven gold standard method for the identification of causative agents of bloodstream infections. Identification of causative organism along with antibiotic susceptibility plays a pivotal role in proposing suitable antibiotic therapy. Automated blood culture systems show improved monitoring of blood cultures by reducing the time and by ensuring more accurate results when compared to the conventional blood culture system.

Materials and methods: The study population of the present study included patients admitted to Chalmeda Anand Rao Institute of Medical Sciences. One hundred and ten hospitalized patients who were admitted over a period of 1 year 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.

Result: All the 110 blood samples were subjected to both conventional and automated blood culture system. Isolation of bacterial pathogens by culture using the automated system showed 31.8% positivity as compared to 20% by conventional blood culture system. P-value regarding isolation of pathogens by automated systems was found to be significant. In conventional blood culture, S. epidermidis was the commonest isolate 14 (35%) followed by E. Coli 10 (25%), S. aureus 4 (10%), Enterobacter cloacae 4 (10%) Acinetobacter iwoffi 4 (10%) and Candida albicans 4 (10%) (Table 2).

Conclusion: Conventional method of blood culture was found to be as efficient as automated blood culture method in respect to rate of isolation of bacteria and yield of bacteria though automated method had significantly shorter mean time of isolation of bacteria than conventional method.

Keywords: Automated culture, Blood culture, Septicemia.

INTRODUCTION

Over the decades, improvements in Blood culture media combined with the availability of automated growth detection have enhanced the recovery of bloodstream pathogens and

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decreased the time to detection (TTD) of bacterial growth. [1] Various continuously monitored BC systems, based on colorimetric (BacT/Alert; bioMérieux) or fluorescence (Bactec; Becton, Dickinson Instrument Systems) detection of CO_2 produced by replicating microorganisms, are used extensively in clinical microbiology laboratories to detect the causative agent(s) of bloodstream infections. [2] Both systems employ resin-containing media in BC bottles (i.e., BacT/Alert FAN Plus or Bactec FX Plus) to enhance organism recovery. Most clinical laboratories commonly pair aerobic and anaerobic BC bottles to better recover the vast array of blood pathogens. [3]

Septicemia or sepsis results when circulating bacteria in blood multiply at a rate that surpasses their elimination by phagocytes. [4] Blood infections are a substantial reason for morbidity and mortality of patients, particularly in developing countries. [5] If left untreated, bloodstream infections may lead to more dangerous infections, involving all organs and ultimately death. [6] Among the various types of nosocomial infections, bloodstream infections are a very serious health problem in hospital wards globally. [7]

Laboratory blood cultures are a proven standard tool for the identification of causative agents of bloodstream infections. [8] Blood cultures provide us information on the causative organism and their antibiotic susceptibility. [9]

This leads to a need for the most effective use of all the accessible procedures for the initial identification of microorganisms causing blood stream infections, which comprises conventional and automated blood culture systems. Technological developments resulted in the accessibility of diverse systems, each appealing to be greater in different facets. Drawbacks of the conventional method require a better diagnostic tool with higher yield and speed.

MATERIALS AND METHODS

The study population of the present study included patients admitted to Chalmeda Anand Rao Institute of Medical Sciences. One hundred and ten hospitalized patients who were admitted over a period of 1 year 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.

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RESULTS

Blood collected from 110 neonates who were clinically suspected of septicaemia were subjected to Bac Talert and VITEK system for identification of the organism and antibiotic sensitivity.

Table 1: Isolation of bacterial pathogens by automated system and conventional system

Blood culture	Automated system		Conventional system		Chi-square	P value
	Number isolated	%	Number isolated	%		
Growth negative	75	68.2	88	80	90.780	0.000
Growth positive	35	31.8	22	20		
Total	110	100	110	100		

All the 110 blood samples were subjected to both conventional and automated blood culture system. Isolation of bacterial pathogens by culture using the automated system showed 31.8% positivity as compared to 20% by conventional blood culture system (Table 1).

Table 2: Bacterial pathogens isolated by conventional method.

Bacteria isolated in conventional method	Number isolated	%
S. aureus	4	10
S. epidermidis	14	35
E. coli	10	25
E. cloacae	4	10
A loffi	4	10
C albicans	4	10
Total (n=110)	40	40.9

In conventional blood culture, S. epidermidis was the commonest isolate 14 (35%) followed by E. Coli 10 (25%), S. aureus 4 (10%), Enterobacter cloacae 4 (10%) Acinetobacter iwoffi 4 (10%) and Candida albicans 4 (10%) (Table 2).

Table 3: Frequency distribution of organisms isolated by automated System.

Culture		Number isolated	%
Gram Positive	***S. haemolyticus,***	26	37.1
	S. epidermidis	11	15.7
	S. werneri	2	2.9
	S. hominis	2	2.9
	S.aureus	5	7.1
Gram Negative	***Enterobacter cloacae***	5	7.1

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	Burkholderia cepacia	3	4.3
	Acinetobacter iwoffi	1	1.4
	S. paratyphi	1	1.4
	E. coli	7	10
Fungi	***C. albicans***	7	10
Total		70	100
Chi-square C2 = 33.294			
P value= 0.000			

The frequency distribution of various organisms isolated by automated method shows S. haemolyticus as the commonest isolate 28 (37.1%) followed by S. epiderimidis 12 (15.7%), E. coli 8 (10%), S. aureus 6 (7.1%), E. cloacae 6 (7.1%), B. cepacia 4 (4.3%) and C. albicans 8 (10%) (Table 3).

DISCUSSION

In our study, out of 110 blood culture samples, All the 110 blood samples were subjected to both conventional and automated blood culture system. Isolation of bacterial pathogens by culture using the automated system showed 31.8% positivity as compared to 20% by conventional blood culture system. These findings are similar with a comparative study that stated 24.1% positive blood culture detected by automated method and 17.9% positive blood culture by conventional method. [9] The yield of bacteria by two methods was also compared in our study. It showed that yield of bacteria by automated method was 100% (29/29) as compared to conventional method which had 89.7% (26/29) yield of bacteria. These findings are similar to a study that showed yield of bacteria by automated and conventional methods were 96.9% and 80%9.

Our study showed In conventional blood culture, S. epidermidis was the commonest isolate 14 (35%) followed by E. Coli 10 (25%), S. aureus 4 (10%), Enterobacter cloacae 4 (10%) Acinetobacter woffi 4 (10%) and Candida albicans 4 (10%). Another recent study had the same finding of highest number of Klebsiella spp (30.66%) followed by Acinetobacter spp (20.0%). [10] The present study showed among the culture positive isolates, 3 (10.2%) were positive only by automated method but none was positive only by conventional method. This may be due to composition of automated vials that contain either resin or charcoal which are responsible for effective removal of antimicrobial agents from blood whereas conventional bottles do not contain these ingredients. So removal of antimicrobial agents is not possible in conventional method. Another congruous study had the findings of 32% blood culture positive samples only by automated method but none were positive by conventional method. [11]

The rate of isolation of bacteria in relation to time has been calculated in our study. The earliest time of isolation of bacteria by automated method was within 12-24 hours interval and the rate of isolation was 51.7% but no bacteria was isolated in 12-24 hours interval by conventional method. The similar findings of 45% isolated bacteria by automated method but none by conventional method in 12-24 hours interval was found in another study that correlated with our

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study8. In the present study highest rate of isolation of bacteria by conventional method was 50.0% in > 24-48 hours. It correlates with a finding of 57.73% isolated bacteria in a comparative study8. Another study stated 34% of isolated bacteria within 48 hours by conventional method. [11]

In our study, mean time for isolation of bacteria by conventional and automated methods were 46.34 hours and 26.38 hours which is similar to a study that showed mean time for conventional and automated methods as 51.09 hours and 28.09 hours. [12] Another study stated that mean time for conventional and automated methods were 66.95 hours and 15.83 hours. [13] In the present study, bacterial isolates were tested for antimicrobial susceptibility by Modified Kirby Bauer Disc Diffusion technique according to CLSI guideline 2010. Among the 18 isolated Klebsiella spp, all were resistant to Ampicillin, Cefotaxime and Ceftazidime which is similar to a relevant study. [14] In our study, most Klebsiella spp were sensitive to Tigecycline which is concordant to a similar study. [15]

In our study, automated system of blood culture had significantly shorter meantime for isolation of bacteria than conventional blood culture system. Many of the laboratory facilities dealing with large number of samples in our country are still based on conventional blood culture system which is labor-intensive for the manpower of the laboratories and also consumes more time and thus delivery of antibiotic sensitivity reports of the patients are further delayed.

CONCLUSION

Conventional method of blood culture was found to be as efficient as automated blood culture method in respect to rate of isolation of bacteria and yield of bacteria though automated method had significantly shorter mean time of isolation of bacteria than conventional method. However, it is impossible to assume a complete picture of comparison between conventional and automated blood culture methods for the diagnosis of neonatal septicemia with different constraints such as limitation of time period and samples. Klebsiella spp was the commonest bacteria isolated by both methods. The isolated bacteria were resistant to most of the antimicrobial agents. So, establishment of automated blood culture system in hospitals where large numbers of patients get admitted can be an alternative to reduce the workload of microbiology laboratory. For this purpose, focusing on maintaining cost effectiveness of automated method along with the accessibility of other requirements should be accepted as areas of concerns.

REFERENCES

1. Wu JH, Chen CY, Tsao PN, Hsieh WS, Chou HC. Neonatal sepsis: a 6-year analysis in a neonatal care unit in Taiwan. Pediatrics & neonatology. 2009 Jun 1;50(3):88-95.

ISSN:0975 -3583,0976-2833 VOL01, ISSUE 03, 2010

2. Mancini N, Carletti S, Ghidoli N, Cichero P, Burioni R, Clementi M. The era of molecular and other non-culture-based methods in diagnosis of sepsis. Clinical microbiology reviews. 2010 Jan;23(1):235-51.
3. Koneman E, Allen S. Koneman. Diagnostico Microbiologico/ Microbiological diagnosis: Texto Y Atlas En Color/ Text and Color Atlas. Ed. Médica Panamericana; 2008.
4. Rajabi Z, Akbari N. Antibiotic susceptibility of strains isolated from blood and urinary tract infections in infants Special care Imam Hossein hospital in Tehran. J Ziste fanavari Microbi 1391;4(12):53-60.
5. Taneja J, Mishra B, Thakur A, Dogra V, Loomba P. Nosocomial blood-stream infections from extended-spectrumbeta-lactamase-producing Escherichia coli and Klebsiella pneumonia from GB Pant Hospital, New Delhi. J Infect Dev Ctries 2010;4(8):517-20.
6. Finland M, Jones WF Jr, Barnes MW. Occurrence of serious bacterial infections since introduction of antibacterial agents. J Am Med Assoc 1959;170:2188-97.
7. Plowman R. The socioeconomic burden of hospital acquired infection. Euro Surveill 2000;5(4):49-50.
8. Nolte FS, Williams JM, Jerris RC, Morello JA, Leitch CD, Matushek S, Schwabe LD, Dorigan F, Kocka FE. Multicenterclinical evaluation of a continuous monitoring blood culture system using fluorescent-sensor technology (BACTEC 9240). Journal of Clinical Microbiology 1993;31(3):552-7.
9. Lazarevic´ G, Petreska D, Pavlovic´ S. Antibiotic sensitivity of bacteria isolated from the urine of children with urinary tract infections from 1986 to 1995. *Srp Arh Celok Lek.* 1998;126(11-12):423–9.
10. Jung S, Yu JK, Shin SH, Park KG, Jekarl DW, Han K. Brief communication: False susceptibility to amikacin by VITEK 2 in acinetobacter baumannii harboring armA. *Ann Clin Lab Sci*. 2010;40(2):167–71.
11. Javiya V, Ghatak S, Patel K, Patel J. Antibiotic susceptibility patterns of Pseudomonas aeruginosa at a tertiary care hospital in Gujarat, India. *Indian J Pharmacol* 2008;40(5):230–4.
24. Sethi S, Sharma M, Kumar S, Singhal L, Gautam V, Ray P.
12. Antimicrobial susceptibility pattern of Burkholderia cepacia complex & Stenotrophomonas maltophilia from North India: Trend over a decade. *Indian J Med Res*. 2007;152(6):656–61.
13. Hasan AS, Uppal P, Arya S, Capoor MR, Nair D, Chellani H, et al. Comparison of BacT/Alert microbial detection system with conventional blood culture method in neonatal sepsis. *J Pediatr Infect Dis*. 2008;3(1):21–5.
14. Jones RN, Ross JE, Fritsche TR, Sader HS. Oxazolidinone susceptibility patterns in 2004: Report from the Zyvox® Annual Appraisal of Potency and Spectrum (ZAAPS) Program assessing isolates from 16 nations. *J Antimicrob Chemother*. 2006;57(2):279-87.
15. Tuohy M, Washington JA. Antimicrobial susceptibility of viridans group streptococci. *Diagn Microbiol Infect Dis*. 1997;29(4):140–5.