EVALUATION OF BLOOD CULTURE EXPERIENCE AT MARMARA UNIVERSITY HOSPITAL

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SUMMARY

Blood cultures submitted to Microbiology laboratory of Marmara University Hospital were reviewed for rate of true positive and false positive results according to patients, medical data and laboratory correlations. Out of 1957 blood samples (taken from 811 patients) 230 cultures (11.8%) from 98 patients have been found to be true positives and 73 cultures (3.7%) from 61 patients were interpreted as false-positives. In 84.5% of blood samples taken from 652 patients no microorganism has been recovered. In regard with the number of patients yielding true positive (98) and false positive (61) cultures, results have also demonstrated that false positive rate was so high indicating in about one-third of the patients, blood culture experience was inappropriate (61 of 159).

Key words: Blood culture, bacteremia, contamination

INTRODUCTION

Blood culturing is a simple procedure, and yields essential information for the evaluation of a variety of diseases including endocarditis, pneumonia and fever of unknown origin. When employment of sterile technique is exactly obeyed, the isolation of bacteria from blood cultures is of major clinical significance. Unfortunately, contamination creates serious problems of interpretation, leading to much wasted effort and expense for both laboratory and ward personnel. Early recognition of contamination would be of value for interpretation of a positive blood culture. Therefore, additional information, i.e., density of bacteremia, number of positive cultures, presence of risk factors and underlying disease, is required in order to determine whether infection is truly present. (1,2).

To evaluate the results obtained from two-year experience of blood culturing at Marmara University Hospital present study has been performed.

MATERIALS AND METHODS

Blood cultures were performed according to conventional procedure recommended by our laboratory as well as the literature (3-5) including employment of sterile technique i.e., skin preparation with application 70% alcohol followed by 1-2% of iodine solution and collecting adequate volume of blood (in a ratio of blood to broth: 1/10).

Biphasic blood culture systems containing Brucella agar and Brucella broth within screw-top bottles were used for the procedure. All cultures were incubated at 37°C for a total period of one month provided being observed daily for the first week, every other day for the second week and twice a week for the remaining two weeks.

All blood cultures were subcultured onto blood agar, chocolate agar and McConkey agar as soon as colonies were observed on the solid phase of biphasic medium.

Medical charts of patients were evaluated for clinical evidence of bacteremia. The data considered were the patient's history and findings of physical examination, temparature course, results of other types of cultures, clinical course and presence of indwelling catheters. From these data a clinical judgement was made as to whether isolated microorganism was representative of true bacteremia or contamination.

RESULTS

Within a two-year period (January 1988-January 1990) 1957 blood cultures from 811 patients were

submitted to Clinical Microbiology Laboratory of Marmara University Hospital. At least one positive culture was obtained afrom 159 of the 811 patients (19.6%), but analysis of clinical data indicated that almost one-third of the patients (38%) and one-fourth (24%) of positive cultures were false positive.

Microorganisms were truly recovered from 98 of 811 patients (12.1%) from whom 230 true positive cultures were obtained (11.8% of the total 1957 blood samples), while 1654 blood samples of 652 patients yielded no microorganism (Table I). Table II and Table III give the list of microorganisms isolated from true positive and false positive cultures, respectively. In general, while true positive isolates were recovered from two or more blood samples, false positive isolates were recovered from one or two samples. Staphylococcus aureus was the most common isolate (isolated from 51 samples of 21 patients), followed by Escherichia coli (isolated from 29 samples of 19 patients). Brucella spp., although recovered from two patients were isolated from 18 blood samples of these patients, similarly 13 Serratia spp were isolated from only three patients. These examples can be increased from the list given in Table II. The majority of organisms isolated from false positive blood cultures were common skin organisms and the most comnon isolate was coagulase negative staphylococci (26 of 73 isolates, %35.6) followed by diphtheroids (23.2%). Although they were isolated in a small percentage microorganisms other than that of skin flora, such as E.coli, Enterobacter-Klebsiella, Pseudomonas, have also been isolated as contaminants. (Table III).

DISCUSSION

Detection of bacteremia has great clinical significance in establishing the primary diagnosis for certain high-risk populations (for example, febrile hospitalized patients, febrile neutropenic patients, and patients with nosocomial infections); comfirming the microbiologic cause of focal infection; providing prognostic information and alerting the physician to potential complications of a focal infection (for example, osteomyelitis or meningitis); providing a means to exclude serious illness (for example, infective endocarditis); and monitoring therapy. In many situations, the positive result in a blood culture directly establishes the diagnosis (for example, infective endocarditis), in other situtations, when the organism causing the infection is difficult to isolate from the primary source, a positive blood culture provides indirect evidence (for example, osteomyelitis).

Although several other assays and methods can be used to detect evidence of bacteremia, the blood culture remains the "gold standard" test for defining that condition (6,7). However; optimal functioning of this test depends on timing, the number of samplings, sterile technique in drawing and handling the blood samples, the volume of blood sampled, the growth characteristics of the medium. It also depends on the clinician's ability to interpret the results since, false positive blood cultures are differentiated from true positive ones on clinical grounds.

The major pitfall in interpretation of blood cultures is their contamination by microbial flora of the skin. This problem is overcome best by careful preparation of the skin with a bactericidal agent. Since infective endocarditis, especially on prosthetic heart valves, may be caused by microorganisms indigenous to the skin, contamination of blood cultures during collection must be reduced to a minimum, ideally less than 3% of all blood cultures taken (3). In the present study this rate was found to be 3.7% which is higher than the ideal. More importantly, it was found that 24% of all positive blood cultures and 38% of the patients with positive cultures yielded false positive results, respectively. Many studies in the literature represent different contamination rates ranging from 2 to 12% (1,8-10). The variation may be explained by technique used for venipuncture because study protocols yield lower rates than routine hospital practice indicating that physician behaviour with respect to sterile techniques greatly influences test performance (11).

Our recovery rate of microorganisms from true positive cultures was only 11.8% in contrast to the literature where the rates are represented within the range of 15.5-31% (1,2,8). There are important factors influencing the recovery rate including timing of blood cultures, volume of blood, number of cultures, and use of antibiotics, For example; in the presence of intermittent chills, blood should ideally be obtained for culture during the hour before the expected chill or temperature spike, since there is usually a lag about 1 h between the influx of bacteria into the bloodstream and the onset of chills, and the blood may be sterile by the time fever begins. Obviously, in practice blood cultures are usually obtained after the onset of fever or chills (3). Similarly, studies have demonstrated that as the volume of blood cultures is increased to 10-20 ml, the yield of positive cultures increases by 30 to 50% (3,10).

In conclusion; guidelines for the optimum use of blood cultures can be summarized as (11):

a. The blood culture is a test that is dependent on physician behavior (that is, use of sterile techniques, and choice of the number, volume, and timing of culture sets).

b. Sensitivity of the blood culture series can be maximized by drawing multiple cultures containing at least 10 ml of blood per set and beginning at the expected onset of a febrile episode.

c. Specificity of the blood culture series can be maximized by adhering strictly to aseptic techniques, by never sampling from an indwelling venous catheter, and by requiring that multiple sets be positive with the same organism for the series to be considered positive when the anticipated isolates are also common contaminants.

d. Strict quidelines cannot be formulated about the number of cultures to be drawn within each series. However, best suggestions include that one blood culture is rarely sufficient; two blood culture sets are necessary and sufficient to establish a diagnosis of bacteremia when the anticipated pathogen is different from the usual contaminating flora; three blood culture sets should be obtained to rule out bacteremia when continuous bacteremia is the dignosis being pursued; four or more blood culture sets should be obtained to rule out bacteremia when the pretest probability of bacteremia is high and either the anticipated pathogens are also common contaminants (as in prosthetic-valve endocarditis) or the patient with suspected endocarditis has received antimicrobials within the prior two weeks.

e. Finally changes in the blood culture system used by the diagnostic microbiology laboratory will affect the performance of the test. Physicians should familiarize themselves with the characteristics of the system used in their clinical setting and work closely with the microbiology staff.

Table I Recovery rate of microorganisms from blood cultures

Recovery of microorganisms	Patients		Blood Samples	
	no	%	no	%
True positive	98	12.1	230	11.8
False positive	61	7.5	73	3.7
Not recovered	652	80.4	1654	84.5
Total	811	100.0	1957	100.0

Table II microorganisms isolated from true positive blood cultures

Microorganisms	Patients		Blood Samples	
	no	%	no	%
Staphylococcus aureus	21	21.4	51	22.2
E. coli	19	19.3	29	12.6
Enterobacter/Klebsiella	10	10.2	16	6.9
Pseudomonas spp.	10	10.2	23	10.0
CNS *	8	8.2	15	6.5
Proteus spp.	5	5.1	9	3.9
Salmonella spp.	4	4.1	11	4.8
Candida spp.	4	4.1	12	5.2
Acinetobacter spp.	3	3.1	6	2.6
Serratia spp.	3	3.1	13	5.7
Group D streptococci	3	3.1	18	7.8
Group B streptococci	2	2.0	3	1.3
Brucella spp.	2	2.0	18	7.8
Citrobatcer spp.	2	2.0	2	0.9
H. influenza	1	1.0	2	0.9
S. pneumonia	1	1.0	2	0.9
TOTAL	98	100.0	230	100.0

* Coagulase negative staphylococci

Table III microorganisms isolated from false positive blood cultures

Microorganisms	Patients		Blood Samples	
	no	%	no	%
CNS *	22	36.1	26	35.6
Diphtheroids	14	23.0	17	23.2
Micrococcus spp.	6	9.8	6	8.9
Bacillus spp.	5	8.2	6	8.2
Staphylococcus aureus	3	4.9	5	6.9
Enterobacter/Klebsiella	3	4.9	4	5.5
E. coli	2	3.2	2	2.8
Pseudomonas spp.	2	3.2	2	2.8
a-hemolytic streptococci	2	3.2	3	4.1
Propionebactedqrium acnes	2	3.2	2	2.1
TOTAL	61	100.0	73	100.0

* Coagulase negative staphylococci

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