

## Evaluation of the use of Bactec anaerobic blood cultures in the detection of bacteraemia and fungaemia in children

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### Abstract

In an attempt to reduce costs, the role of Bactec anaerobic blood culture in the detection of bacteraemia and fungaemia in children was evaluated. Results from 3167 sets of aerobic and anaerobic blood cultures from children admitted to the University Hospital, Kuala Lumpur during a one year period, were analysed. Four hundred and eight (12.9%) sets of blood cultures were positive, of which 348 sets (11.0%) from 201 patients were clinically significant. Of the 348 significant positive sets, organisms were isolated on 177 (50.9%) occasions from both aerobic and anaerobic bottles, on 136 (39.1%) occasions from the aerobic bottle only and 35 (10.0%) occasions from the anaerobic bottle only. No strict anaerobes were isolated, but clinically significant isolates recovered from the anaerobic bottle only included *Klebsiella pneumoniae*, *Salmonella* species, *Enterobacter cloacae*, *Staphylococcus aureus*, coagulase negative staphylococci, *Streptococcus pneumoniae* and Group B streptococcus. Patients with bacteraemia diagnosed solely by anaerobic culture were distributed evenly across the various paediatric subspecialties. When results from the anaerobic bottles were excluded, the overall isolation rate was reduced from 11% to 9.9%. Potential financial savings resulting from omission of anaerobic cultures must be balanced against the small number of bacteraemic episodes that could be missed. Undiagnosed bacteraemia may result in increased morbidity and mortality with its own attendant financial implications.

*Key words:* Bacteraemia, blood cultures, paediatric infections

### INTRODUCTION

The large numbers of blood culture specimens received by many laboratories has necessitated the use of automated technology such as the Bactec Non-radiometric System (Becton Dickinson Diagnostic Instrument Systems, Sparks, Maryland, USA). Equipment and media are expensive and this is especially true for developing countries.

Anaerobic bacteraemia in children is rare and reported blood culture isolation rates range from 3%,<sup>1</sup> to as low as 0.07%.<sup>2</sup> At the University Hospital, Kuala Lumpur it has been the practice of the Paediatric Department to take blood for both aerobic and anaerobic culture on all children, including neonates, with suspected bacteraemia or fungaemia.

In an attempt to reduce costs we questioned the need for anaerobic culture from all paediatric patients and in this study we report the analysis of blood culture results for a one year period.

### MATERIALS AND METHODS

*Study period and patients.* Results of all blood cultures from paediatric patients in the University Hospital, Kuala Lumpur, for the period October 1st, 1994 to September 30th, 1995 were reviewed. The University Hospital has 162 beds for paediatrics including intensive care, oncology and paediatric surgery (general and cardiothoracic) and there is also an eight-bed neonatal unit.

*Blood culture system.* During the study period, blood from patients with suspected bacteraemia or fungaemia was equally distributed into one Bactec Peds Plus bottle and one Bactec 17A bottle (Becton Dickinson Diagnostic Instrument Systems, Sparks, Maryland, USA). The Peds Plus and 17A bottles are formulated for aerobic and anaerobic culture respectively. Bottles were run on a five-day cycle on the Bactec Non-radioactive 730 system bottle (Becton Dickinson Diagnostic Instrument Systems, Sparks, Maryland, USA).

**Identification of isolates and clinical significance.** Organisms isolated were identified by standard methods.<sup>3</sup> The time taken for detection of each positive culture was recorded for each bottle. The significance of each positive blood culture was determined by liaison with the paediatricians and was based upon clinical findings and results of complementary laboratory investigations.

## RESULTS

A total of 3167 sets of aerobic and anaerobic blood cultures were received during the study period. Four hundred and eight (12.9%) sets of blood cultures were positive, of which 348 (11.0%) sets from 201 patients were considered to be clinically significant. When considering clinically significant infections only, organisms were isolated on 177 (50.9%) occasions from both

aerobic and anaerobic bottles, on 136 (39.1%) occasions from the aerobic bottle only and 35 (10.0%) occasions from the anaerobic bottle only. When both bottles were positive, clinically significant organisms were isolated on 126 (71.2%) occasions from both bottles at the same time, 35 (19.8%) occasions from the aerobic bottle first, and on 16 (9.0%) occasions from the anaerobic bottle first. Thus, if results from the anaerobic blood culture bottles are ignored the overall number of significant positives detected was 312 which corresponds to an isolation rate of 9.9%.

No strict anaerobes were isolated. The clinically significant organisms isolated from the different bottles are shown in Table 1.

The effect of positive blood culture results on the clinical management of individual patients

TABLE 1: Clinically significant blood culture isolates from 201 patients

Organism (number of patients)*	Number occasions that cultures were positive in		
	Aerobic bottle only	Both bottles	Anaerobic bottle only
<i>Staphylococcus aureus</i> (32)	11	29	5
Coagulase negative staphylococci (30)	15	35	8
<i>Streptococcus pneumoniae</i> (5)	1	2	2
Group B streptococcus (7)	2	4	1
Group G streptococcus (2)	1	1	0
<i>Enterococcus faecalis</i> (6)	6	2	1
Alpha and non-haemolytic streptococcus (3)	0	9	0
<i>Corynebacterium</i> species (2)	2	0	1
<i>Bacillus</i> species (3)	3	1	0
<i>Haemophilus influenzae</i> type b (3)	2	1	0
<i>Escherichia coli</i> (19)	3	21	4
<i>Klebsiella pneumoniae</i> (38)	6	36	9
<i>Enterobacter cloacae</i> (10)	1	9	1
<i>Citrobacter freundii</i> (2)	1	2	0
<i>Proteus mirabilis</i> (1)	0	1	0
<i>Salmonella</i> species (7)	2	3	2
<i>Salmonella typhi</i> (1)	1	0	0
<i>Pseudomonas aeruginosa</i> (7)	7	0	0
<i>Pseudomonas</i> species (7)	7	1	0
<i>Stenotrophomonas maltophilia</i> (2)	5	0	0
<i>Flavobacterium</i> species (2)	2	0	0
<i>Acinetobacter calcoaceticus</i> (15)	34	4	0
<i>Aeromonas hydrophila</i> (3)	0	9	1
<i>Candida</i> species (12)	24	7	0
TOTAL	136	177	35

\*The total number of patients is greater than 201, since on 10 occasions more than one organism was isolated in a bottle.

TABLE 2: Characteristics of bacteraemia diagnosed by recovery of organisms from the anaerobic bottle only.

Organism	No. of patients	Types of infections
<i>Staphylococcus aureus</i>	4	Pneumonia, neonatal sepsis, leukaemia with iv line associated sepsis, neuroblastoma with iv line associated sepsis
Coagulase negative staphylococcus	2	Iv line associated sepsis
<i>Streptococcus pneumoniae</i>	2	Pneumonia
Group B streptococcus	1	Neonatal sepsis
<i>Enterococcus faecalis</i>	1	Iv line associated sepsis
<i>Escherichia coli</i>	3	Urinary tract infection, neonatal sepsis, leukaemia with sepsis
<i>Klebsiella pneumoniae</i>	4	Neonatal sepsis, sepsis post laparotomy, leukaemia with sepsis
<i>Enterobacter cloacae</i>	1	Neuroblastoma with sepsis
Salmonella species	2	Acute gastroenteritis

was examined for all the occasions when organisms were isolated from the anaerobic bottle only. Twenty-seven patients had blood cultures that were positive in the anaerobic bottle only of a set of blood cultures, but seven of these patients had further sets of blood cultures taken where there was growth with an identical organism in the aerobic bottle also. In the remaining 20 patients, bacteraemia was detected solely as a result of anaerobic culture. The organisms and the associated infections of these patients are summarised in Table 2.

## DISCUSSION

During this study no strict anaerobes were isolated and this finding is in agreement with the previously published low rates of anaerobic infection in children.<sup>1,2</sup> Omission of the anaerobic bottle would result in an estimated saving of 40,000 Malaysian Ringgit *per annum*, with only a small reduction in the overall isolation rate. Unfortunately the decision to omit anaerobic culture is not that simple. Ten percent of positive blood cultures were positive in the anaerobic bottle only and on these occasions facultative anaerobes were isolated. Thus in some patients

bacteraemia with organisms such as *S. aureus*, *S. pneumoniae*, Group B streptococcus and members of the *Enterobacteriaceae* would have been missed had the anaerobic bottle not been used. Increased morbidity and mortality resulting from failure to detect bacteraemia has its own financial implications which may themselves cancel the savings made by omission of routine anaerobic culture. Patients with bacteraemia diagnosed solely by anaerobic culture were distributed evenly across the various paediatric subspecialties and included patients with community acquired infections, neonatal sepsis, neutropenic sepsis and hospital acquired infections such as intravenous line associated sepsis. It would thus appear impossible to formulate a specific policy identifying categories of patients not requiring anaerobic culture.

The fact that the anaerobic bottle is perhaps more important for the isolation of facultative anaerobes rather than strict anaerobes appears to have been ignored by most workers, with the exception of Murray and colleagues,<sup>4</sup> who critically analysed the use of anaerobic blood cultures in adults. These investigators also recognised that on some occasions facultative

anaerobes may preferentially grow in the anaerobic bottle, but despite this observation still concluded that it would be better to omit anaerobic culture in most situations. Why some facultative anaerobes are isolated only from the anaerobic bottle is unknown. Volumes of blood collected from children are often very small and it is possible that isolation of organisms from the anaerobic bottle alone may be due to a sampling effect. What is unknown, however, is whether organisms would have been isolated had all the blood been cultured in the aerobic bottle rather than being distributed into two bottles. There is evidence in adults, summarised by Mermel and colleagues,<sup>5</sup> that increasing the volume of blood cultured will increase the isolation rate. Sampling effects cannot explain all the cases of growth in the anaerobic bottle alone; in one patient in this study, coagulase negative staphylococci were isolated on six successive occasions from the anaerobic bottle only. Many of the patients were already on antibiotics when the cultures were taken (data not shown). The Peds Plus bottle has a lower volume (20ml) than the 17A bottle (30ml) and injection of equal volumes of blood into both bottles would result in greater dilution of antibiotic and other inhibitory substances in the anaerobic bottle compared to the Peds Plus bottle. This effect should be negligible though, since both types of blood culture bottle contain resins designed to inhibit antimicrobial activity.

In conclusion, omission of anaerobic culture would result in substantial financial savings but would also reduce the overall isolation rate. The potential financial savings must be balanced against the small number of bacteraemic episodes that could be missed since undiagnosed bacteraemia resulting in increased morbidity and mortality has its own financial implications. Other laboratories will need to examine their own practices as differences in patient populations and medical practices may result in relative recovery rates of organisms that are different to those reported in this investigation.

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