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Role of Blood Cultures in Management of Pediatric Community-Acquired Pneumonia in Cairo

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Abstract: Community-Acquired Pneumonia (CAP) is a serious infection in children with a high rate of morbidity and mortality. Blood Cultures (BCs) have been aroutine but controversial part of the diagnostic investigation of this disease. BCs may be misleading due to false positive results. To test the hypothesis that false positive BC results exceeds true positives among BCs obtained from the in-patient sections of a referral hospital in Cairo, Egypt and to determine the frequency with which physicians change antibiotic therapy based on BC results. This cohort study was conducted in New Children's Hospital, Cairo University (Abu El-Reish) from January to December 2005. One hundred and eighty three patients met study inclusion criteria , Data was collected using written medical records system containing admission and discharge data, radiological results and laboratory results (complete blood count and blood cultures) and treatment given. Of the 183 study patients, 26 (14.3%) had positive BCs. There were 7(4%) patients with true positive BCs and 19 (10%) patients with false positive BCs containing contaminants. Eight patients (5%) had their antibiotic regimen changed based on blood culture results. One hundered and seventy five patients (95%) had their antibiotic plan maintained or changed based on clinical grounds. Blood cultures are of limited value in the clinical management of CAP patients. The benefits of utilizing blood cultures to guide antibiotic treatment are outweighed by the costs and time involved in performing these cultures.

Key words: Community-acquired pneumonia, blood cultures, treatment of pneumonia in children

INTRODUCTION

Community-Acquired Pneumonia (CAP) is one of the most common serious infections in children (Marti-Carvajal and Conterno, 2006; Zar and Madhi, 2006; Stein and Marostica, 2006; Porzecanski and Bowton, 2006; Canton *et al*., 2006). *Streptococcus pneumoniae* is the most common bacterial cause of CAP after the neonatal period (Marriott and Dockrell, 2006). When diagnosing community-acquired pneumonia, physicians rely mainly on the patient's history and physical examination, chest radiographs and laboratory tests as needed. Knowing the age-specific causes of bacterial pneumonia will help guide antibiotic therapy (Ostapchuk *et al*., 2004). Traditionally, Blood Cultures (BCs) have been a routine part of the diagnostic investigation of this disease and have been considered mandatory by some authors (Bartlett *et al*., 2000; Niederman *et al*., 2001). However, others have suggested that BCs are of little clinical value, particularly among immunocompetant infants with CAP (Porzecanski and Bowton, 2006; Canton *et al*., 2006). BCs may be misleading due to false positive results. Many investigators have questioned the need to obtain blood cultures from all patients hospitalized with pneumonia (Chalasani *et al*., 1995; Waterer *et al*., 1999; Campbell *et al*., 2003; Theerthakarai *et al*., 2001; Waterer and Wunderink, 2001). In an effort to quantify the clinical utility of BCs in Egyptian immunocompetant infants and young children with CAP, this study was designed to test the hypothesis that the proportion of false positive BC results exceeds the proportion of true positives among BCs obtained from the in-patient sections of a referral hospital in Cairo. We also intended to determine the frequency with which physicians change antibiotic therapy based on BC results.

MATERIALS AND METHODS

This cohort study was conducted in New Children's Hospital, Cairo University (Abu El-Reish) from January to December 2005. During this period, 360 patients were admitted to the hospital with CAP. Of which 183 patients met study inclusion criteria which were:1-age from one month to 5 years, 2-Presence of chest x ray infiltrates, 3-

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performance of blood culture, 4- No recent admissions, 5- No long term corticosteroid use and 6- having no other immunocompromised states. The remaining 177 children who did not fulfill these criteria or refused to participate in the study were excluded. Data was collected using written medical records system containing admission and discharge data, radiological results and laboratory results (complete blood count and blood cultures) and treatment given.

Microbiological workup: A single blood culture from each child was collected and processed in the microbiology lab of New Children's Hospital, Cairo University (Abu El-Reish) by incubation of the bottles for 5 days on the BACTEC 9050® system (Becton Dickinson®) and were sub-cultured according to the standard operating procedures of the laboratory if they were flagged as positive during this period. A BC consisted of a pair of aerobic and anaerobic FAN bottles. FAN medium was formulated to improve microbial recovery, particularly for fastidious microorganisms and for microorganisms causing sepsis in patients receiving antimicrobial therapy. BCs were considered negative if they grew no organisms after five days. Organism identification and antibiotic susceptibility were done according to National Committee of Clinical Laboratory Standards (NCCLS). The BCs were classified as false positive if the treating physicians concluded that the organism was a contaminant and treated the patient, accordingly. Otherwise, positive BCs were classified as true positives. True negative BCs were defined as those in which initial BCs were negative and subsequent BCs, if obtained, were either negative or contained an organism classified by the physicians caring for the patient as a contaminant. False negative BCs were defined as those in which initial BCs were negative, but subsequent BCs, if obtained, contained an organism classified by the physicians caring for the patient as a true pathogen rather than a contaminant. Antibiotic sensitivities were obtained for all positive cultures

Table 1: Main clinical and laboratory characteristics of patients (n =183)

Variables	Value
Age (month)	
Mean+/- SD	50.6+/- 13.9
Range	1-60
Lymphocytes	
Mean+/- SD	11.8+/-11.2
Range	7-79
Sex	
Mean+/- SD	31+/- 13.2
Males	109
Females	74
Ratio	4/3
Weight	
Mean+/- SD	7.3+/- 3.2
Range	2.5-20
Admission temperature	
Mean+/- SD	38.4+/- 0.8
Range	36-40
Admission respiratory rate (breath min^{-1})	
Mean+/- SD	57.6+/- 10.2
Range	25-90
Duration of admission	
Mean+/- SD	9.3+/- 4.5
Range	1-24
Total leucocytic count	
Mean+/- SD	14.2+/- 12
Range	3500-97000

Statistical analysis: Data were exported to an Excel® spreadsheet. Statistical analysis was then performed using SPSS 11.0 ®software. Frequency distribution and percentage distribution tables were used to illustrate the results, ranges and means±one Standard Deviation (SD) were calculated (Table 1).

RESULTS AND DISCUSSION

Of the 183 study patients, 26 (14.2%) had positive BCs. There were 7(3.8%) patients with true positive BCs and 19 (10.4%) patients with false positive BCs containing contaminants. Of the 7 patients with true positive BCs, three grew *Staphylococcus aureus* and one grew *Staphylococcus haemolyticus* and one for each *Acinetobacter, Serratia* and *Klebsiella*. Of the 19 patients with false positive blood cultures, 16 grew Coagulase negative Staphylococci, two grew budding yeast and one patient grew two organisms (Coagulase negative Staphylococci plus *Enterobacter*). There were no false negative BCs that we were able to detect (Fig.1). When examining the initial empiric antibiotic therapy, most of the

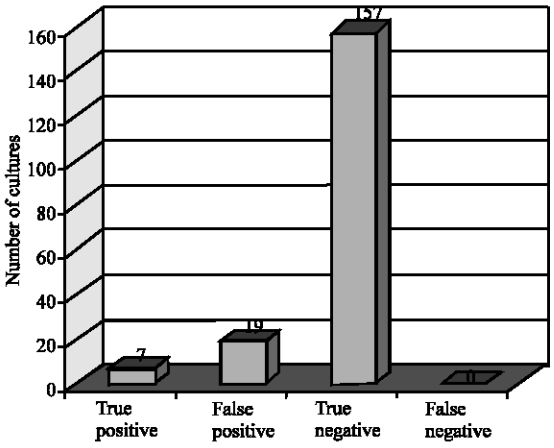

Fig. 1: Blood culture results

Table 2: Initial empiric antibiotic therapy before blood culture

Initial empiric antibiotic therapy	Number of patients (%)
Penicillin derivatives	38 (21)
Ampicillin + aminoglycosides	72 (39)
Ampicillin + Cephalosporin + Aminoglycosides	13 (7)
Others	60 (33)
Total	183 (100)

Table 3: Changes in antibiotic therapy after blood culture

Blood culture classification	Blood culture results (%)	Change in antibiotic therapy in response to culture results
True positive	7 (4)	7 of 7 (100%)
False positive	19 (10)	1 of 19 (5.3%)
True negative	157 (86)	Based on clinical grounds
False negative	0 (0)	Non

patients (39%) received a combination of ampicillin plus an aminoglycoside, 21% received penicillin and 7% received ampicillin plus cephalosporin plus an aminoglycoside antibiotic (Table 2). Seven patients had their antibiotic regimen changed by the results of their true positive BC. One of the 19 false positives had a change of antibiotics secondary to BC results (Table 3). In total, of the studied 183 patients, eight patients (5%) had their antibiotic regimen changed based on blood culture results. A total of 175 patients (95%) had their antibiotic plan maintained or changed based on clinical grounds such as worsening of symptoms or continued fever (18 patients with false positive BC and 157 patients with true negative BC). All patients who had their antibiotic regimen changed were cured. The overall mortality in children with pneumonia was 8.5%. In this cohort study, we examined the BC results of 183 immunocompetant children aged 1 month to 5 years admitted to the hospital with clinical and radiographic diagnosis of CAP. We examined only children who were immunocompetant because of their lower bacteraemia rate (Niederman *et al*., 2001). Our results showed a rate of true positive BCs of 4%, with a higher rate of false positive BCs of 10%. A study by (Chalasani *et al*., 1995) in adults with similar exclusion criteria found comparable rates of true positive BCs of 6.8%. However, their false positive BCs (4.8%) were lower than our results. This could be explained by their better aseptic technique during sample collection resulting in decreased incidence of false positive culture results. In addition, many organisms that cause pneumonia in children do not result in bacteremia and therefore do not yield a positive blood culture. The Coagulase-Negative Staphylococci (CoNS), aerobic and anaerobic diphtheroids, *Micrococcus* sp. and *Bacillus* sp. are known contaminants (Weinstein, 2003). When a single blood culture was obtained and revealed one of the likely contaminants, the treating physician reviewed the patient's chart and judged the clinical significance of the isolate (Weinstein, 2003). All organisms identified in the true positive BCs group were resistant to the antibiotics initially chosen empirically by the clinician. The percentage of antibiotic change after BC results was 100%. This finding is comparable to that reported in the study by Chalasani *et al*. (1995), Woodhead *et al*. (2006). Bates *et al*. (1991) showed that the results of false positive BCs caused an increase in duration of hospital stay and thus an increase in hospital costs. In this study, we did not include hospital costs. However, we found that a clinician would typically broaden antibiotic coverage to a more costly third generation cephalosporin. Waterer *et al*. (1999) reported that only 20% of eligible cases were actually narrow to penicillin therapy, have noted this phenomenon. We found that the patient's clinical evaluation (95%) had a far stronger influence on change of antibiotic therapy than the results of BCs (5%). This is comparable to the reports of Stuurman *et al*. (1996) who performed a retrospective study on 1350 patients discharged from the hospital after BC. True positive results were found in 1.8% of them and only 0.52% of patients had BC results that changed the antibiotic management. Although the frequency of true positive results was low, they provided important information on the antibiotic resistance that resulted in a change in treatment. Possible additional benefits from true positive results include the administration of more appropriate antibiotic therapy with potential money savings by avoiding inappropriate treatment and their associated potential adverse reactions.

CONCLUSION

The conclusion of this study is limited by the small sample size and the results may not be generalizable to other populations or facilities that may be able to obtain serial blood cultures or where the contamination rate is lower. However, this study provides data that can be useful in the design of future research on a larger scale aimed at studying the utility of BCs in other patient populations. Possible other areas of study include measuring the utility of interventions to improve blood culture techniques and decrease contamination rates, identifying patients who are more likely to benefit from BCs and educating clinicians about the use of BC results and the impact of BC results on the choice of antibiotic therapy. This study evaluated the role of BCs in the management of CAP in a referral children's hospital in Cairo, Egypt. The study proved the hypothesis that the proportion of false positive BC results exceeds the proportion of true positives among BCs obtained in the in-patient sections. Since the incidence of bacteraemia in pneumonia is low (Ramanujam and Rathlev, 2006; Enwere *et al*., 2006; Aspa *et al*., 2006) we can conclude that blood cultures are of limited value in the clinical management of

CAP patients included in this study. Although the hospital days were not different between patients who antibiotic changed and who were not, the benefits of using blood culture to guide antibiotic treatment are outweighed by the costs and time involved in performing these cultures.

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