Antibiotic Prescribing Patterns of Pediatric Residents: Do the Results of Blood Cultures Make a Difference?

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ABSTRACT

The diagnosis of bacteremia relies on the isolation and identification of the bacteria from blood cultures, whether they are community-acquired or nosocomial in origin. However, studies have shown that, in the Philippines alone, physicians have been found to underutilize these laboratory examinations.

Objectives: The goal of this study was to determine the influence of positive blood cultures and sensitivity test results on the antibiotic choices of pediatrics residents at the University of the Philippines – Philippine General Hospital (UP-PGH).

Methods: A chart review of patients with positive blood cultures, who were 18 years old and below, and admitted initially at the UP-PGH Pediatric Emergency Room (UP-PGH PER) from August 1, 2004 to July 31, 2005 was performed. Excluded were patients who died before the release of the blood culture reports or discharged per request or against medical advice, post-operative patients, patients with presumed polymicrobial sepsis, and patients with contaminated blood cultures.

Results: One hundred twenty two (122) patients with positive blood cultures were included: 87 or 71.3% of the isolates were community-acquired, the most common pathogens of which were gram-positive bacteria, *Staphylococcus epidermidis* (18.3%), followed by gram-negative *Salmonella* (11.5%). Among the patients diagnosed with bacteremia at the UP-PGH PER, *Staph. epidermidis* was also the most common pathogen; with 34% of all isolates acquired nosocomially. Other significant isolates included *Pseudomonas putida, Pseudomonas aeruginosa*, and *Klebsiella sp.*

Prior to the release of the blood culture and sensitivity results, 45 of the 122 patients were already discharged. Therapy at the time of discharge was of questionable efficacy, accounting to 73.3%. Of the 77 patients discharged after the release of blood culture and sensitivity (CS) results, only 21(27%) of the antibiotic therapies were modified, and 56 (73%) were not modified at all. It is imperative to know, however, that 50% of the antibiotic therapies were modified a day after the corresponding blood culture and sensitivity (CS) results came out for patients who presented with nosocomial infection.

Conclusion: In general, blood culture and sensitivity test results have a limited effect on the antibiotic choices of pediatric residents at the UP-PGH (University of the Philippines – Philippine General Hospital).

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INTRODUCTION

Mortality as a result of bacteremia has been reported to be as high as 35% to 50%. [1, 2] Risk factors for a fatal outcome include compromised status of the host, age, type of organism, and shock. The frequency of bacteremia has been increasing steadily. According to Pittet et.al. the rate of bloodstream infection has been reported at 200,000 individuals annually.[3] Knowledge of the most common etiologic agents involved in a particular bacteremia, therefore, is of paramount importance because it facilitates the physicians' selection of appropriate antibiotic therapy. Blood cultures are routinely included in the evaluation of febrile patients, but empiric antibiotics are often started even before culture results become available. Hence, physicians in a particular community or institution should be able to determine the most prevalent organisms in order to avoid any delay in the management of patients. Accordingly, adjustments in the antibiotic regimen based on the culture and sensitivity results should be made. However, in the Philippine General Hospital alone, there is little information whether residents are indeed influenced by the blood cultures and sensitivity results.

In 1994, Arbo, et. al. found that blood cultures have a limited effect on antibiotic choices when they observed that there was underutilization of the culture and sensitivity results.[4] In a study done by Edwards, et. al., they concluded that there was no consistent logical approach to the use of bacteriologic results, in as much as only 20.9% of positive cultures had an effect on antibiotic therapy.[5] In the Philippines, there are no available data on how physicians, who request for bacteriologic examinations, utilize bacteriologic results. However, in 1995, Panaligan, et. al. made a study to determine the influence of positive blood cultures and sensitivity tests (among adult patients) on the antibiotic choices of attending physicians at the University of the East – Ramon Magsaysay Memorial Medical Center (UERMMC). They found out that blood culture and sensitivity results have a limited effect on the antibiotic choices of attending physicians in their institution. Underutilization of bacteriologic studies was reaffirmed in their study. [6]

The aim of this study was to determine the influence of positive blood cultures and sensitivity tests on the antibiotic choices of pediatric residents at UP-PGH.

MATERIALS AND METHODS

Study Design

A retrospective and descriptive study which utilized chart review of patients, who were 18 years old and below was performed.

Data Collection: Initial information gathered included the total number of patients admitted from August 1, 2004 to July 31, 2005 at the UP-PGH PER. The logbooks of the Section of Microbiology (on the aforementioned dates) were then reviewed to determine the total number of blood cultures, as well as, the list of patients whose blood cultures turned positive.

Included in the chart review were patients below 18 years old who were seen at the UP-PGH ER from August 1, 2004- July 31, 2005 with positive blood cultures. The patient charts were excluded if they expired prior to the release of their blood culture results, were discharged per request or against medical advice, had polymicrobial sepsis, post-operative patients or patients with contaminated blood cultures.

Information gathered from the charts included the patients' possible source of infection, diagnosis, antimicrobial treatment (both the empiric treatment, as well as, the change made after the release of the blood culture results), the final disposition of the antibiotic regimen—whether the attending resident changed the antibiotic regimen accordingly or not (either resistant or of questionable efficacy), and the disposition of the patients.

Outcomes Measured

These included the number of blood cultures performed in the UP-PGH PER, the top isolates

from blood cultures done within the first 48 hours after admission (community-acquired bacteremia), as well as, the top isolates from blood cultures done 48 hours after admission (nosocomial bacteremia) at UP-PGH PER, the number of pediatric residents who modified or not their antibiotic therapy according to the sensitivity patterns of positive isolates from blood cultures and determination if the modification or non-modification of the antibiotic regimen was appropriate, inappropriate (resistant), or of questionable efficacy.

Statistical Analysis

Data analysis of the output was done using descriptive statistics of distribution of community-acquired bacteremia, distribution of nosocomial bacteremia, and outcomes of antibiotic modification of patients with blood culture and sensitivity results released prior to discharge.

RESULTS

A total of 1098 patients were subjected to blood culture studies from August 1, 2004 to July 31, 2005, averaging about 91.5 blood cultures per month. Of the 1098 blood cultures done, 19.7% or 217 patients showed positive blood culture results, while 80.3% or 881 patients showed negative blood culture results.

Of the 217 patients with positive growths, 5 were post-operative patients, 4 were presumed to have polymicrobial sepsis, and the 17 either died, went home against advice, went home per request, or were discharged. 31 other charts were, unfortunately, irretrievable. Of the 160 charts reviewed, 38 were not evaluated because their blood culture isolates were deemed contaminants. There were 122 episodes of bacteremia; 87 (71.3%) were community-acquired while 35 (28.7%) were hospital-acquired. Table 1 shows the distribution of community-acquired bacteremia pathogens. 34.5% were caused by Gram (+) organisms, the most common of which was *Staphylococcus epidermidis*, which accounted for 18.3% of all pathogens. Gram (-) *Salmonella* came in second, comprising 11.5% of all community-acquired pathogens.

Table 1. Distribution of community-acquired bacteremia pathogens. [N = 87 of 122 (71.3%)]

Pathogen	**N (%)**
Staphylococcus	30 (34.5)
S. epidermidis	16(18.3)
S. aureus	9 (10.4)
S. saprophyticus	5 (5.8)
Salmonella	10 (11.5)
Salmonella Group C	4 (4.6)
Salmonella Group D	4 (6.9)
E. coli	10 (11.5)
Streptococcus	10 (11.5)
S. pneumoniae	7 (8)
S. viridans	3 (3.5)
Citrobacter	5 (5.8)
Enterobacter	5 (5.8)
E. agglomerans	2(2.3)
E. cloacae	3 (3.4)
Proteus mirabilis	4 (4.6)
Klebsiella	4 (4.6)
K. ozanae	2 (2.3)
Klebsiella spp.	2 (2.3)
Acinetobacter baumanii	3 (3.4)
Serratia marscecens	2 (2.3)
Bacillus spp.	2 (2.3)
Burkholderia mallei	1 (1.1)
Micrococium luteum	1 (1.1)

Staphylococcus epidermidis comprised the majority of cases of nosocomial-acquired bacteremia, which accounted for 34.3% of all pathogens. Other pathogens included *Pseudomonas putida* (14.3%) and *Pseudomonas aeruginosa* (8.6%).

Forty-five of the 122 patients were already discharged prior to the release of blood culture and sensitivity results. Table 3 shows the patients who were discharged after the blood culture results came out.

Of the 77 patients discharged after the release of blood culture and sensitivity results, only 21 or 27% of the antibiotic regimens were modified, and 56 or 72.7% were not modified at all.

Table 2. Distribution of nosocomial bacteremia pathogens. [N = 35 of 122 (28.7%)].

Pathogen	**N (%)**
Staphylococcus	14 (40)
S. epidermidis	12(34.3)
S. aureus	2 (5.7)
S. saprophyticus	5 (5.8)
Pseudomonas	8 (22.9)
P. putida	5 (14.3)
P. aeruginosa	3 (8.6)
Acinetobacter	4 (11.4)
A. baumanii	2 (5.7)
A. wolfii.	2 (5.7)
Achromobacter	2 (5.7)
Alkaligenes faecalis	2 (5.7)
Burkholderia cepacia	1 (2.9

Table 3. Patients with blood culture and sensitivity results released prior to discharge and appropriateness of antibiotic modification.

		With modification (n = 21)			Without modification (n = 56)		
		A	I	U	A	I	U
	N	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
CAB	51	7 (33)	0	1 (5)	29(52)	2 (4)	12 (21)
NB	26	12(57)	0	1 (5)	4 (7)	2 (4)	7 (12)
Total	77	19(90)	0	2(10)	33(59)	4(7)	19(34)

CAB= community acquired bacteremia
NB= nosocomial bacteremia
A= Appropriate
I= Inappropriate
U= Undetermined

Twenty one pediatric residents modified their empiric treatment: 19 (90.5%) modifications were evaluated as appropriate (pathogen was sensitive to the antibiotic given), while only 2 were deemed either of questionable or unknown efficacies against the particular blood isolate.

Fifty six residents did not make any modifications in their antibiotic treatment. Of the 56 non-modifications, 33 patients (58.9%) were already being given appropriate antibiotic coverage, while only 4 were given antibiotics which were resistant to the pathogen. The patients at that time were seen with "clinical improvement".

DISCUSSION

Changes in the microbiology, epidemiology, and clinical and prognostic significance of bacteremia both in the community and hospital settings have been observed over the last 20 years. Studies done in the early 60s and 70s by McCabe[7, 8] showed an increasing frequency of gram-negative bacteremia. However, recent reports have revealed that gram-positive organisms are now assuming greater significance in bacteremia, concomitant with the increasing incidence of nosocomial bloodstream infection.[9,10] Such change happened parallel to the evolution of medical care, more so with the increasing number of critically-ill and immunocompromised patients requiring aggressive medical support and in-dwelling devices. This is also true in this study, wherein Gram (+) organisms accounted for the majority of the isolates, whether community-acquired or nosocomially-acquired, although majority of the organisms isolated were Gram (-) organisms.

The most striking finding in our study is the prevalence of *Staphylococcus epidermidis* as the leading cause of both community and nosocomial bacteremia. This is one of the many recognized species of coagulase-negative staphylococci affecting or colonizing humans. Residents are quick to maintain that such pathogen is merely a "contaminant", since its low virulence usually requires the presence of another factor, such as immune compromise or foreign bodies like peritoneal dialysis catheters and prosthetic cardiac valves, etc., for clinical

disease to develop. Likewise, it is a common skin inhabitant and may indeed contaminate poorly collected blood cultures, making it difficult to differentiate bacteremia from contamination.[11]

In other local studies, *Salmonella* was the predominant organism isolated among community-acquired bacteremia. In this study, however, the Salmonella group may have accounted for most of the gram-negative organisms among community-acquired isolates, but they only came in second next to the Staphylococcus group of organisms.

Other community-acquired isolates included *E. coli*, *Streptococcus* group, *Citrobacter sp*., *Enterobacter sp*., and *Proteus mirabilis*.

A concern which continually haunts each and every pediatric resident is the impact of nosocomial bacteremia. Studies have shown that nosocomial infection accounts for a higher mortality—the majority of which were associated with catheter-related intravascular infections.[11] Ideally, patients should stay at any emergency room only for a few hours; patients may either be admitted to the wards or discharged, accordingly. However, due to overstaying, and sometimes overcrowding, patients at the UP-PGH PER may be exposed to nosocomial infections. The emergency room is a rich environment for the growth of microorganisms. To date, there is no available study on the isolates taken from patients who are presumed to have acquired nosocomial bacteremia from this Institution. Recent studies have shown a changing trend in the etiology of hospital-acquired bacteremia. Common causes of nosocomial bacteremia in children are seasonal viruses and gram-negative bacilli. Although *Pseudomonas* and *Klebsiella* have continued to be important causes of nosocomial bacteremia, of particular interest is the resurgence of staphylococcal species as a major cause of nosocomial infection in this Institution, not only in the Pediatric Emergency Room, but in all departments of the Philippine General Hospital.

Studies have shown that promptness and appropriateness of treatment were equally important factors in determining the survival in bacteremia. The starting of any antibiotic regimen is based on a residents' initial assessment of a patient who comes in at the emergency room, or when the patient is presumed to have acquired nosocomial infection. But to request for a blood culture study is to give credence to the fact that such measure is being used for the diagnosis of bacteremia in children and that bacteria are usually found in high concentrations in the blood of pediatric patients with sepsis. However, this study has shown that treatment decisions were based mainly on the resident's present working impression, and that blood culture and sensitivity results have little influence on the decision of attending residents regarding modification of antibiotic therapy. A majority of residents did not make any modifications in their antibiotic therapy, for reasons worthy to be investigated on future studies.

From the study presented, it is noteworthy that nosocomial infections are indeed seen in the Pediatric Emergency Room. Although most PER residents, interns, and nurses are always in a "rush", still, the prevention of further spread of infection is the goal. Basic practices that have to be observed in any unit of any medical institution include improved hand hygiene, cleaning of shared equipment between uses (including intubation sets, suction catheters, etc.), separation of patients with certain pathogens, avoidance of overcrowding, and selective decolonization.

There is also a need to reevaluate whether blood culture studies are indeed indicated for patients who get admitted at the emergency room. Indications may depend on host factors and certain criteria; but if the trend continues for residents not modifying their antibiotic therapy despite blood culture and sensitivity results, is there really a need to do such culture studies?

CONCLUSIONS

We have presented in this study that only a minority of patients' blood cultures done in UP-PGH PER have shown positive results (19.7% of all blood cultures done). The most common pathogen isolated, which caused bacteremia among pediatric patients 18 years and below, was *Staphylococcus epidermidis*, for both community and nosocomial bacteremia.

From majority of blood culture results, only a small number of residents modified their empiric treatment, while more than half made no modifications at all despite the blood culture and sensitivity results. Blood culture and sensitivity results, then, have limited influence on decision making.

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