Nosocomial Bloodstream Infection in Pediatric Patients: Siriraj Hospital, Bangkok; 1996-1999

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Abstract

A retrospective study on nosocomial bloodstream infection (NBSI) in pediatric patients hospitalized at Siriraj Hospital from January 1996 to December 1999 was performed. Of the 18,087 blood specimens sent for culture, 533 (3%) were positive for organisms after 72 hours of hospitalization and were defined as NBSI. The rate of NBSI detected in blood culture specimens was highest among neonates (5.2%). Gram-positive cocci and gram-negative rods caused NBSI in an equal proportion (46% and 44% respectively) and *Candida* caused 10 per cent of NBSI. Coagulase-negative staphylococci was the most common pathogen followed by *K. pneumoniae* and *Enterobacter*. Antibiogram showed that 15 of the 35 (43%) *S. aureus* identified were methicillin-resistant. Only 35-38 per cent of *Enterobacteriaceae* were sensitive to cefotaxime or ceftazidime. Cefoxitin was still effective against 95 per cent of *K. pneumoniae*. Compared with other third generation cephalosporins, combination of cefoperazone and betalactamase-inhibitor (sulbactam) possessed an increased *in vitro* efficacy against *K. pneumoniae, Enterobacter, E. coli, Acinetobacter* and non-fermentative gram-negative rods. Resistant rate of amikacin among all gram negative rods was 25-69 per cent. Ciprofloxacin sensitivity varied from 62-100 per cent among all gram-negative rods. Imipenem was excellent against all gram-negative rods with the sensitivity of 80-100 per cent. Epidemiological data of this study is important for the decision of the appropriate empirical antimicrobial treatment in our hospital.

Key word : Nosocomial, Bacteremia, Thai Children, Bloodstream Infection

MONGKOLRATTANOTHAI K, CHOKEPHAIBULKIT K, KOLATAT T, et al
J Med Assoc Thai 2001; 84: 160-165

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Nosocomial bloodstream infection (NBSI) remains a significant problem worldwide. NBSI results in a considerable morbidity and mortality, prolongation of hospitalization and increases indirect and direct patient care expenditures[1]. The incidence of NBSI is influenced by age[2], birth weight[3,4], underlying disease[5], severity of illness[6], length of central venous catheter use[7,8], being cared for in an intensive care unit [2,9], type of hospital[10] and finally, intensity of surveillance and the definitions used[8]. The pattern of causative pathogens and antibiotic susceptibility may be differrent in individual institutions particularly in different regions. It is important to obtain these data which may help clinicians decide the appropriate empirical treatment for NBSI. The purpose of this study was to determine the pattern of pediatric NBSI and antibiogram of these pathogens in our institution.

METHOD

NBSI is defined as bacteremia that occurs after 72 hours of hospitalization. In this study, the patients also had to have clinical findings compatible with bloodstream infection at the time of positive blood culture. The results of multiple positive blood culture from the same patient in the same episode were considered single infection.

From January 1996 to December 1999, microbiologic data of NBSI among pediatric patients at Siriraj Hospital, a 300 pediatric bed-facility tertiary care center, were analyzed. The antimicrobial susceptibility pattern was also evaluated.

RESULTS

During the 4 year period, 533 episodes of NBSI was identified in pediatric patients. Of the age-specific rate of NBSI identified among the blood samples sent for culture, neonates was the age group with the highest rate; 5.2 per cent (Table 1). Gram-positive cocci and gram-negative rods caused NBSI in equal proportion (46% *vs* 44%). *Candida* accounted for 10 per cent. The most common pathogen was coagulase-negative staphylococci (CNS), which was predominant in all age groups. *K. pneumoniae* was the second most common cause of NBSI (Table 2).

Of the *S. aureus* isolates causing NBSI, 43 per cent (15/35) were methicillin-resistant. On the other hand, of the CNS isolates, 81 per cent were methicillin-resistant and 12 per cent were teicoplanin-resistant. There was no isolate of vancomycin-resistance among *S. aureus* or CNS.

The sensitivity pattern of gram-negative rods causing NBSI is shown in Table 3 and 4. There was a high resistant rate to cephalosporin among *Enterobacteriaceae*; with the exception that cefoxitin was still effective against 95 per cent of *K. pneumoniae*. Ceftazidime was effective against 76 per cent of *P. aerugenosa*. In comparison with other third generation cephalosporins, combination of cefoperazone and betalactamase-inhibitor (sulbactam) possessed an increased *in vitro* efficacy against *K. pneumoniae, Enterobacter, E. coli, Acinetobactor* and non-fermentative gram-negative rods (NF), but the efficacy was not increased against *P. aerugenosa*. Resistance to amikacin among all gram-negative rods

Table 1. Age-specific rate of nosocomial bloodstream infection identified from the blood samples of pediatric patients sent for culture from January 1996 to December 1999.

Age (months)	No. of blood specimens sent for culture	No. of positive cultures	%
<1	3,666	189	5.2
1-12	5,505	137	2.5
13-36	3,379	81	2.4
37-60	1,843	41	2.2
>60 months -12 years old	3,694	85	2.3
Total	18,087	533	3

Table 2. Etiologic of nosocomial bloodstream infection in different age groups.

Pathogens	Age (mo) <1	1-12	13-36	37-60	>60	Total
Gram-positive						
CNS[1]	79	49	21	10	17	176
S. aureus	14	9	8	1	3	35
Streptococci	8	5	4	9	10	36
Total	101	63	33	20	30	247 (46%)
Gram-negative						
K. pneumoniae	29	15	9	2	10	65
E. coli	7	6	2	3	8	26
P. aerugenosa	6	5	8	3	8	30
Enterobactor	18	9	6	3	6	42
Salmonella	3	5	1	-	8	17
Acinetobacter	8	4	3	2	4	21
NF[2]	5	7	9	-	-	21
Other GNR[3]	2	2	2	1	4	11
Total	78	53	40	14	48	233 (44%)
Candida	10	21	8	7	7	53 (10%)
Total	189	137	81	41	85	533 (100%)

[1]CNS = Coagulase-negative staphylococci
[2]NF = Non-fermentative gram-negative rod
[3]GNR = Gram-negative rods

Table 3. Antibiotic sensitivity pattern among *Enterobacteriaceae*.

Antibiotics	*K. pneumoniae*	%	*Enterobactor*	%	*E. coli*	%
Cefazolin	13/47	28	1/37	2.7	5/17	29
Cefoxitin	41/43	95	1/30	3.3	12/20	60
Cefotaxime	18/49	37	21/37	57	9/21	43
Ceftazidime	17/48	35	22/38	58	9/19	47
Cefoperazone-sulbactam	25/38	66	30/36	83	14/16	87
Amikacin	19/38	50	22/32	69	12/17	70
Ciprofloxacin	32/35	91	25/25	100	12/17	70
Imipenem	52/52	100	39/40	97	21/21	100

causing NBSI was very common, from 25 per cent to 69 per cent. Ciprofloxacin was very effective against *K. pneumoniae, P. aeruginosa* and *Enterobactor*. Imipenem was excellent for all gram-negative rods except for NF, of which the sensitivity to imipenem was only 80 per cent.

DISCUSSION

NBSI continue to be an expensive complication of hospitalization(1). The pattern of pathogen changes over time as the result of changing patterns of medical practice and intervention. This has been well demonstrated in the US where gram-negative rod was isolated predominantly in NBSI in the late 1970's but gram-positive cocci was predominant instead in the 1990's(11). The utility of antibiotics has caused the emergence of resistance more recently than it has in the past.

The most recent study in the US including 49 hospitals across the country found gram-positive cocci caused nearly two-third of NBSI, gram-negative rods caused approximately a quarter and *Candida* caused approximately 8 per cent of NBSI. Coagulase-negative staphylococci was the most common pathogen(11). The pattern of pathogens and antimicrobial

Table 4. Antibiotic sensitivity pattern among other gram-negative rods.

Antibiotics	*P. aerugenosa*	%	*Acinetobacter*	%	NF[1]	%
Amikacin	18/24	75	8/19	42	5/16	31
Cefotaxime	4/30	13	1/21	5	7/21	33
Ceftazidime	22/29	76	5/21	24	10/17	59
Cefoperazone-sulbactam	23/27	85	13/16	81	15/15	100
Ciprofloxacin	20/22	90	11/17	65	8/13	62
Imipenem	29/30	96	21/21	100	16/20	80

[1]NF = Non-fermentative gram-negative rod

susceptibility in each institution can be significantly different(12). In our study, similar to the US study, CNS was the most common pathogen and 80 per cent of CNS isolates were methicillin-resistant. However, the rate of methicillin-resistance among *S.aureus* was higher in our study than in the US study (43% *vs* 30%). The relative rate of gram-negative bacilli infection in our study was also higher (44% *vs* 32%), and the proportion of *Candida* was quite similar (10% *vs* 8%). In contrast to what found in the US study, we did not find *Enterococci* to be a problem in our institution. The data from our study underscored the importance of surveillance in each hospital.

The antibiotic susceptibility pattern of *S. aureus* and gram-negative rods was alarming. We must emphasize the optimal use of antibiotics and adopt strategies to help reduce the resistance problem such as rotation of antibiotics, avoidance of broad-spectrum antibiotics, and use of combination antimicrobial therapy(13). A good communication system between laboratory and clinicians is very crucial for cooperation with the strategy. The strategy of the changing pattern of antimicrobial use may reduce the antibiotic resistance problem. Decreased usage of cephalosporin, imipenem, clindamycin and vancomycin has shown to help to reduce the incidence of methicillin-resistant *S. aureus* and ceftazidime-resistant *K. pneumoniae*(14).

We need to continue active surveillance on NBSI. Knowing of the change in rate, pattern of pathogens and antimicrobial susceptibility will help the intervention strategy on antimicrobial use for the best outcome and prevention of resistance. We cannot emphasize more for the continuation of education among health care teams. The most important issue is how to prevent NBSI. Avoidance of a central venous catheter, sterile technique for caring of the intravenous catheter and meticulous handwashing remain the key issues for controlling NBSI(15).

(Received for publication on September 22, 2000)

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ผลการศึกษาการติดเชื้อในกระแสโลหิตที่เกิดในโรงพยาบาล ในผู้ป่วยเด็ก โรงพยาบาลศิริราช พศ. 2539–2542

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รายงานฉบับนี้เป็นการศึกษาย้อนหลังถึงระบาดวิทยาของการติดเชื้อในกระแสโลหิตที่เกิดขึ้นในโรงพยาบาล หลังจากผู้ป่วยเข้ารับการรักษาในโรงพยาบาลเป็นเวลานานเกินกว่า 72 ชั่วโมง ของภาควิชากุมารเวชศาสตร์ โรงพยาบาลศิริราช ตั้งแต่เดือนมกราคม พศ. 2539 ถึงเดือนธันวาคม พศ. 2542 พบว่าจากจำนวนเลือดทั้งหมดที่ส่งเพาะเชื้อ 18,087 ตัวอย่าง มีจำนวนเลือด 533 ตัวอย่าง (ร้อยละ 3) ที่พบเชื้อในกระแสโลหิตซึ่งเป็นการติดเชื้อในโรงพยาบาล พบว่าวัยทารกแรกเกิดเป็นกลุ่มช่วงอายุที่มีอัตราการพบเชื้อจากตัวอย่างเลือดที่ส่งตรวจมากที่สุด (ร้อยละ 5.2) เชื้อที่พบเป็นเชื้อกรัมบวกและกรัมลบ ในอัตราส่วนที่ใกล้เคียงกัน (ร้อยละ 46 และร้อยละ 44 ตามลำดับ) พบเชื้อราในอัตราร้อยละ 10 เชื้อที่พบได้บ่อยที่สุดจากการศึกษาครั้งนี้คือเชื้อ coagulase–negative staphylococci และเชื้อที่พบได้รองลงมาเป็นอันดับสอง คือ *K. pneumoniae* และ *Enterobacter* ตามลำดับ

ผลการศึกษาความไวต่อยาปฏิชีวนะของเชื้อที่แยกได้จากการศึกษาครั้งนี้พบว่าเชื้อ *S. aureus* มีอัตราการดื้อต่อ methicillin ร้อยละ 43 (15/35 ตัวอย่าง) เชื้อกลุ่ม *Enterobacteriaceae* ไวต่อยา cefotaxime หรือ ceftazidime เพียงร้อยละ 35–58 แต่ *K. pneumoniae* ยังคงไวต่อยา cefoxitin สูงถึงร้อยละ 95 ความไวต่อยากลุ่ม cefoperazone ร่วมกับ sulbactam จะดีกว่ายากลุ่ม third generation cephalosporin เดี่ยวๆ ต่อเชื้อ *K. pneumoniae, Enterobacter, E. coli, Acinetobacter* และ non–fermentative gram negative rods อัตราการดื้อยา amikacin ในกลุ่มเชื้อกรัมลบสูงถึงร้อยละ 25–69 ยา ciprofloxacin มีอัตราความไวประมาณร้อยละ 62–100 ต่อเชื้อในกลุ่มกรัมลบ ยา imipenem ยังคงมีประสิทธิภาพดีมาก โดยมีอัตราความไวประมาณร้อยละ 80–100 ต่อเชื้อในกลุ่มกรัมลบทั้งหมด

ผลจากการศึกษาครั้งนี้จะเป็นประโยชน์เพื่อช่วยให้แพทย์ตัดสินใจในการเลือกใช้ยาปฏิชีวนะที่เหมาะสมเพื่อให้การรักษาการติดเชื้อที่เกิดในโรงพยาบาลได้ผลดียิ่งขึ้น

คำสำคัญ : ติดเชื้อในโรงพยาบาล, ติดเชื้อในกระแสโลหิต, ผู้ป่วยเด็ก

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