

Bacteriological Spectrum of Neonatal Sepsis

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Abstract

Background: To determine the spectrum of causative bacteria and their antibiotics sensitivity and resistance patterns in neonatal sepsis.

Methods: In this descriptive study 50 newborns having blood culture proven septicemia were included. Neonates delivered at home or other health facility and consent refused by parents / guardian of neonate were excluded. Information regarding the organisms grown on blood culture (done by BACTEC method) was noted along with the sensitivity and resistance patterns (checked by standard disc diffusion method) of commonly used antibiotics. During analysis, frequencies and percentages for all categorical variables, i.e. organisms grown on blood culture, their antibiotic sensitivity and resistance patterns, gender, birth weight (low, very low or normal), gestational age (pre, post or term), mode of delivery (vaginal or caesarean section) and age of onset of illness (early or late), were calculated.

Results: A total of 50 newborns with blood culture proven neonatal sepsis were included in this study. The predominant microorganisms isolated were gram negative (84%), with *Enterobacter* as the most common organism (48%) followed by *E. coli* (16%), *Klebsiella* (14%) and *Pseudomonas* (6%). *Staphylococcus aureus* was the most common (10%) among gram positive microorganisms, followed by *Streptococcus pneumoniae* (6%). The microorganisms isolated in this study were found to be highly resistant to the antibiotics tested. The overall resistance pattern showed that 74% of the organisms were resistant to ampicillin, 52% to cefotaxime, 72% to ceftazidime, 60% to ceftriaxone, 42% to amikacin, 14% to imipenem, 42% to ofloxacin, and 56% to aztreonam.

Conclusion: Gram negative bacteria are the commonest cause of neonatal sepsis and the most common organism encountered was *Enterobacter* (48%). The resistance to commonly used antibiotics is noted to be alarmingly high.

Key Words: Neonatal sepsis, Sensitivity and resistance, Antibiotics.

Introduction

Sepsis is the commonest cause of neonatal mortality. Sepsis related mortality is largely preventable with rational antimicrobial therapy and aggressive supportive care. As bacteriological organisms of neonatal sepsis vary from time to time, a regular surveillance of neonatal units to assess prevailing bacteriological spectrum and their antibiotic sensitivity and resistance pattern is required for appropriate antibiotics policy.

Neonatal sepsis, also termed sepsis neonatorum, is a clinical syndrome characterized by systemic signs of infection, shock and organ failure. Diagnosis is confirmed on positive culture from normally sterile site. It is also defined as a bacterial infection in a neonate in the first four weeks of life that is documented by a positive blood culture.¹ It is classified into early onset sepsis (that occur within 7 days of life) and late onset sepsis (from 7 till 28 days of life). Neonatal sepsis is a frequent and important cause of neonatal morbidity and mortality world wide.¹ It contributes to 6 million deaths per year and nearly accounts for 40% of deaths in first weeks of life. Its incidence in developed countries varies from 1-10/1000 live births, where as it is 3 times more common in developing countries like Pakistan.

Bacteriological agents leading to neonatal sepsis may vary from place to place. The exact reason is unknown but geographical, socioeconomic, seasonal and prevalent use of various antibiotics may play an important role.^{2,3} Most common bacterial organisms responsible for early onset neonatal sepsis in developed countries, includes coagulase-negative staphylococcus (CoNS) and Group B streptococcus (GBS). In developing countries like Pakistan, India, Nigeria and Bangladesh, *Escherichia coli* (*E. coli*), *Klebsiella* and *Staphylococcus aureus* (*S. aureus*), are major pathogens involved in early onset sepsis (EOS).^{4,5}

Late onset sepsis (LOS) occurs between 8-28 days of life. Organisms implicated in causing late-onset sepsis in developed countries include CoNS, S.aureus, E coli, Klebsiella, Pseudomonas, Enterobacter, Candida species, GBS, Serratia, acinobacter, and anaerobes. While in developing countries E.coli, S.aureus, GBS are common.⁶

The best method of diagnosis of neonatal sepsis and identification of bacteria is blood culture. Current automated blood culture systems like BACTEC which continuously monitor blood culture, by checking each bottle every few minutes helps in earlier detection of bacterial growth.¹

Bacterial agents of neonatal sepsis vary from time to time. Gram negative organisms were the most common causes of neonatal sepsis in Europe and America in 1960s. It changed to Group B streptococcus during 1970 and Coagulase negative staphylococcus during late 1980s and 1990s. At the same time there have been an increase in antibiotic resistance over the past two decades which is due to mutant forms of common bacteria, overuse, or under use or inappropriate use of broad spectrum antibiotics and poor infection control in maternity and neonatal units.^{2,4,5,7}

Patients and Methods

This descriptive study was conducted in Department of Neonatology, Children’s Hospital, Pakistan Institute of Medical Sciences, Islamabad during 6 months, from 28 January to 28 July 2008. A sample size of 50 patients was determined by Purposive non probability technique. All neonates born at Maternal and Child health centre, Pakistan Institute of Medical Sciences, Islamabad, having blood culture proven septicemia were included. Neonates delivered at home or other health facility and Consent refused by parents / guardian of neonate were excluded. Information regarding the organisms grown on blood culture (done by BACTEC method) was noted along with the sensitivity and resistance patterns (checked by standard disc diffusion method) of commonly used antibiotics in the department. During analysis, frequencies and percentages for all categorical variables, i.e. organisms grown on blood culture, their antibiotics sensitivity and resistance patterns, gender, birth weight (low, very low or normal), gestational age (pre, post or term), mode of delivery (vaginal or caesarean section) and age of onset of illness (early or late), were calculated.

Results

Out of 50 newborns with blood culture proven neonatal sepsis, 46% were delivered at term, 38% were preterm and 16% were post term. The birth weight of the newborns was normal in 60% cases, 24% were having low birth weight and 16% very low birth weight. There were 76% spontaneous vaginal deliveries (SVD) and 24% delivered through cesarean section . There were 28 (56%) female babies and 22 (44%) male babies with a female to male ratio of 1.2:1. Twenty three (46%) newborns presented with early onset neonatal sepsis and 27 (54%) with late onset neonatal sepsis .

Out of 50 positive blood cultures the predominant microorganisms were gram negative with Enterobacter as the most common organism followed by Escherichia coli, Klebsiella and Pseudomonas. Staphylococcus aureus was the most common among gram positive microorganisms followed by Sterptococcus pneumoniae (Table 1).The antibiotic sensitivity pattern revealed varied resistance pattern to different antibiotics like Ampicillin (74%), Cefotaxime (52%), Ceftazidime (72%), Ofloxacin (42%) and aztreonam (56%) (Table 2).

Table 1: Neonatal Sepsis- Organisms isolated

Organism	No(%)
Early Onset Neonatal Sepsis (n=23)	
Enterobacter	9 (39.1)
E. coli	6 (26.1)
Klebsiella	4 (17.5)
S. aureus	1(4.3)
S.pneumoniae	3 (13.0)
Late Onset Neonatal Sepsis (n=27)	
Enterobacter	15 (55.6)
E. coli	2 (7.4)
Klebsiella	3 (11.1)
S. aureus	4 (14.8)
Pseudomonas	3 (11.1)

Discussion

Neonatal sepsis is a leading cause of mortality and morbidity in neonates in our country.^{2,4,5} In our study, Enterobacter was common in both early (39.1%) and late onset sepsis (55.6%).These results are in contrast to previous studies done in Pakistan.^{2,4,5} However a study conducted by Hunter et al and Torkaman et al reported Enterobacter as an emerging pathogen for causing neonatal sepsis.^{8,9} Outbreaks of Enterobacter in different centres were also noted time to time.¹⁰ While E.coli was isolated in only 16% cases of

Table 2: Sensitivity and Resistance Pattern of different microorganisms.

Organism	Antibiotics									
	Ampicillin	Cefotaxime	Ceftazidime	Ceftriaxone	Amikacin	Imipenam	Ofloxacin	Aztreonam	Vancomycin	
Enterobacter	S	29.20%	41.70%	20.80%	29.20%	41.70%	91.70%	3330.00%	41.70%	-
	R	70.80%	58.30%	79.20%	70.80%	58.30%	8.30%	6670.00%	58.30%	-
E-coli	S	12.50%	62.50%	25.00%	50.00%	75.00%	87.50%	87.50%	50.00%	-
	R	87.50%	37.50%	75.00%	50.00%	25.00%	12.50%	12.50%	50.00%	-
Klebsiella	S	28.60%	57.10%	28.60%	28.60%	85.70%	85.70%	100.00%	28.60%	-
	R	71.40%	42.90%	71.40%	71.40%	14.30%	14.30%	0.00%	71.40%	-
S.aureus	S	0.00%	20.00%	0.00%	40.00%	60.00%	80.00%	80.00%	66.70%	100.00%
	R	100.00%	80.00%	100.00%	60.00%	40.00%	20.00%	20.00%	33.30%	0.00%
Pseudomonas	S	66.70%	66.70%	100.00%	66.70%	33.30%	33.30%	66.70%	33.30%	-
	R	33.30%	33.30%	0.00%	33.30%	66.70%	66.70%	33.30%	66.70%	-
S.pneumoniae	S	66.70%	66.70%	66.70%	100.00%	100.00%	100.00%	33.30%	66.70%	-
	R	33.30%	33.30%	33.30%	0.00%	0.00%	0.00%	66.70%	33.30%	-

S: sensitivity, R: resistance

neonatal sepsis, previous studies showed that it was the most common organism in both early and late onset neonatal sepsis as reported by Brekhna et al. Haque et al. Waheed et al. and Jiang et al.^{2-4,11}

In present study Klebsiella was isolated in 14% cases of neonatal sepsis. It was the third most common pathogen isolated while it has been reported to be the most common pathogen by a number of researchers.^{6,12,13}

Similarly S.aureus causes only 10% cases of neonatal sepsis. However it is second most common cause of late onset sepsis (14.8%) in this study. S.aureus was the leading pathogen causing neonatal sepsis as reported by Javed et al and Shaw et al.^{14,15}

Pseudomonas and Streptococcus pneumoniae were also isolated in this study. Each of them is involved in 6 % cases of neonatal sepsis. A study reported by Mustafa et al showed Pseudomonas as the second most common cause of neonatal sepsis in their unit.² It was also reported by Lee et al and Zaidi et al as the leading pathogen of neonatal sepsis.^{16,17} While Streptococcus pneumoniae is a rare but fatal cause of neonatal sepsis.¹⁸

The microorganisms isolated in this study showed high resistance to the antibiotics tested. Out of the 24 isolated Enterobacters, 70.8% were resistant to ampicillin, 58.3% to cefotaxime, 70.8% ceftriaxone, 79.2% ceftazidime, 8.3% imipenam, 58.3% amikacin, 66.7% ofloxacin and 58.3% aztreonam. Singhi et al. has also reported high degree of resistance of

Enterobacter to commonly used antibiotics.¹⁹ Other gram negative organisms i.e. E.coli and Klebsiella isolated in this study also showed high level of resistance to the antibiotics tested. Viswanathan et al from India reported the highest antibiotic resistance pattern in that all gram negative bacteria in their study were resistant to ampicillin, amoxicillin, cefotaxime, ceftazidime, ceftriaxone, and aminoglycoside.²⁰ A recent study conducted in Pakistan shows high degree of resistance of gram-negative organisms to ampicillin (79%), cefotaxime (55%), ceftazidime (71%), amikacin (22%).² Another study revealed resistance of a high proportion of E. coli against ampicillin (72%), cotrimoxazole (78%) and third generation cephalosporins (19%). Among Klebsiella species, almost all were resistant to ampicillin, 45% to cotrimoxazole, and 66% to third generation cephalosporins. Resistance to gentamicin was low among Esch. coli (13%), but much higher among Klebsiella species (60%).²¹ In another study Hasvold et al also reported ampicillin and gentamicin resistance emerging in neonatal E. coli infection.²²

Staphylococcus aureus also showed a high rate of resistance to antibiotics tested. All of the isolated S. aureus were resistant to ampicillin and ceftazidime, 80% were resistant to cefotaxime, 60% ceftriaxone, 20% imipenam, 40% amikacin, 20% ofloxacin and 40% to aztreonam. Similar pattern of antibiotics resistance of S. aureus was also reported by Tariq.²³ While Dzidic et

al have also reported emergence of methicillin resistant staphylococci, vancomycin resistant enterococci, extended spectrum beta lactamase producing gram negative bacilli and identify these a major problem in management of neonatal sepsis.⁹

Antibiotic resistance is increasing world wide. To tackle this problem a comprehensive approach is needed. This involves unit based microbiologic surveillance, infection control procedures like hand washing and strict aseptic measures, taken while handling the patients, need to be reinforced. Patients infected with resistant organisms should be isolated and antibiotics should be given judiciously to the pregnant mothers.

Conclusion

1. Neonatal sepsis is a commonly encountered problem in our setup. Principally gram negative organisms cause neonatal sepsis in our country. Multidrug resistant gram negative organisms are common.
2. There is a need to review the antibiotics policy. Irrational and unsupervised use of antibiotics should be discouraged.
3. There should be greater emphasis on the prevention of neonatal sepsis. As bacteriological organisms of neonatal sepsis vary from time to time, future studies are also required to know the changing bacteriological spectrum.

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