Neonatal sepsis antimicrobial susceptibility pattern of blood culture isolation

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Abstract

Background: Neonatal mortality and morbidity in well-developed countries are commonly caused by neonatal septicemia. The pediatricians will decide related to the empirical treatment of neonates by using their susceptibility and their knowledge of microbial flora.Objective: The major reason for conducting this research was to study those neonates who were diagnosed with suspected neonatal sepsis and evaluate the antimicrobial susceptibility of blood culture isolation in them.Study design: A cross-sectional studyPlace and Duration: This study was conducted at Shaheed Mohtarma Benazir Bhutto Medical College Lyari Karachi from June 2021 to June 2022Methodology: This is laboratory-based research which was conducted in our hospital. All the patients were diagnosed with suspected neonatal sepsis and were admitted to the department of pathology of the hospital. The patients underwent sensitivity and blood culture testing. The disk diffusion method was used to carry out the antimicrobial susceptibility testing of blood culture isolation. This test was conducted using the guidelines provided by CLSI (Clinical Laboratory Standard Institute).Results: A total of 200 samples were collected out of which some were excluded and the rest were from 46 males and 30 females. The average age calculated was 13 days. The age ranges from 1 day to 28 days. E. coli (n=10), S. aureus (n=28), Acinetobacter spp. (n=8) and K. pneumoniae (n=9) were the common isolates. Methicillin-resistant Staphylococcus aureus (MRSA) constituted 25 percent of positive isolates. 6 patients showed pseudomonas aeruginosa isolation. The most effective antimicrobial against isolated gram-positive was linezolid. Linezolid showed 93.7 percent sensitivity.Conclusion: S. aureus, E. coli, and K. pneumonia are the major microorganisms that cause neonatal sepsis in our hospital.

Keywords: Bacteria, sepsis, newborn, infections

Introduction

To diagnose neonatal sepsis, the existence of a positive blood culture adds up to its gold standard of diagnosis[1]. Because of bacteremia in the first month of life, some symptoms and systematic signs are seen in a clinical condition. This clinical condition is called neonatal sepsis[2]. This clinical condition can also be due to nosocomial infection. Nosocomial infection is developed within 4 to 6 days after admission to the hospital[3]. NICU (Neonatal Intensive Care Units) are occupied with patients diagnosed with neonatal sepsis. There are a number of factors involved with this which are the following; gender, gestational age, weight, the severity of disease, invasive procedures repeating such as assisted ventilation, central venous catheterization, immunodeficiency, parenteral nutrition, and use of antimicrobials[4, 5]. According to the World Health Organization (WHO), sepsis causes 1.6M neonatal deaths every year worldwide[6]. Overall 40 percent of these deaths occur in well-developed countries[7]. If appropriate and proper treatment is not provided on time, neonatal sepsis can become life-threatening. Furthermore, this clinical condition is

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very challenging to be diagnosed because it shows very nonspecific symptoms and signs[8]. There may be a possibility that the microorganisms that cause neonatal sepsis show diversity in hospitals of the same region[9]. In the NICUs, the most preferred and used medications are antibiotics[10]. Since various NICUs use varied amounts of antibiotics, it is necessary to implement antibiotic governance[11]. In certain situations, starting antibiotics may be less beneficial and more harmful and the neonatologists and pediatricians should be made aware of this[12]. In this vulnerable population, taking a quick antibiotic treatment to treat major infections can result in a positive outcome. However, if the antibiotics are not used sufficiently or properly, this can lead to an increase in the number of dangerous bacteria which are resistant to several drugs[13]. By depending upon the common antibiotics and local pathogens that are used in neonatal hospitals, the antibiotic susceptibility patterns may differ geographically. Due to lack of response to current antibiotics, antimicrobial resistance is emerging and becoming a serious public health concern.

To manage neonatal sepsis effectively, the neonatologists should have a proper understanding of neonatal sepsis and its pathogenesis. They should also have current and updated information about the etiological agents that would be used and their antibiotic sensitivity profile. The representative samples and the bacteriological culture of blood are two important things that help in the quick diagnosis of neonatal sepsis. Neonatal sepsis can be caused by a number of pathogens that are the following; P. aeruginosa, K. pneumoniae, Enterobacter spp., S. aureus, Proteus mirabilis, Enterococcus spp., and E. coli. Multi drug resistant (MDR) bacteria emerged because of the usage of the vast variety of resistance mechanisms by these bacteria. This forces the clinicians to turn over to colistin, vancomycin, and carbapenems. It is very important to have proper knowledge regarding neonatal sepsis, the pathogens that cause this clinical condition, their antimicrobial susceptibility profile, their importance, and how to select the appropriate therapy using antibiotics that will lower the rate of neonatal mortality and morbidity[14].

The major reason for conducting this research was to study those neonates who were diagnosed with suspected neonatal sepsis and evaluate the antimicrobial susceptibility of blood culture isolation in them. This would help in formulating upgraded guidelines related to antibiotics for their utilization in neonatal sepsis.

Methodology

This research is a laboratory based research which was performed in our hospital. All the patients were diagnosed with suspected neonatal sepsis and were admitted to the neonatal ward of the hospital. The patients underwent sensitivity and blood culture testing regardless of their weight and age.

Exclusion criteria

Those patients whose samples were repeated and showed growth of similar sensitivity and microorganisms were not a part of this research.

Before initiating the antimicrobial therapy, 1 to 2 ml of blood was collected. Chocolate agar, MacConkey agar, and Sheep Blood Agar were used daily for about seven days to subculture the blood cultures. For quality control of plates of MacConkey agar, chocolate agar, and Sheep Blood Agar (SBA), some pathogens were used as control strains. Those pathogens were P. aeruginosa, E. coli, and S. aureus. The plates of chocolate agar were incubated in a humid atmosphere which was enriched with CO2. This was done by using a candle jar at 35 °C for about 4 days. The plates of MacConkey agar and SBA were incubated aerobically. After 7 days of incubation, those blood cultures bottles were claimed to be negative and showed no growth.

Biochemical tests, gram staining, and serology were used to detect the microorganisms. In order to determine the associated organisms, the analytical profile index API-20E was used. Moreover, to determine P. aeruginosa and Acinetobacter spp. according to the manufacturer's directions, API-20NE was used. Certain tests were conducted to confirm S. aureus. These tests were the catalase test, coagulase test, gram staining, and DNase test. Bile esculin, NaCl broth test, catalase test, gram stain, and arabinose test were used to identify Enterococcus spp. using the Kirby-Bauer disc diffusion method in accordance with the CLSI protocol, antibacterial susceptibility testing of the isolates with 0.5 McFarland standards was performed on prepared MHA[15]. Moreover, standard antibiotic disks that were commercially available were also used. CLSI guidelines were used to measure and record the zones of inhibition. The antibiotics used for susceptibility testing were gentamicin, ciprofloxacin, clindamycin, erythromycin, trimethoprim, amikacin, linezolid, and doxycycline. For MRSA screening, cefoxitin was used.

SPSS version 17 was used to analyze the data statistically. The SD (standard deviation) and mean for variables such as gender, age, and antimicrobial susceptibility pattern of bacteria were calculated.

Results

During the research period, a total of 200 samples were collected. Out of 200, there were 76 samples that yielded growth and the negative staphylococci were excluded. Out of 76 samples, 46 samples were from males and 30 samples were from females. The average age calculated was 13 days. The age ranges from 1 day to 28 days. There were a total of 44 samples that showed gram-negative bacilli and 32 samples that showed gram-positive cocci. The most common gram-negative isolate was E. coli. Table number 1 shows the culture positivity with respect to gender and age. Table number 2 shows the frequency of positive isolates. Table number 3 shows the susceptibility pattern of gram-positive isolates.

Table No. 1: culture positivity with respect to gender and age.			
	Positive (n)	Negative (n)	Total (n)
Age			
<7 days	32	44	76
Gender			
Females	12	18	30
Males	20	26	46

Table No. 2:frequency of positive isolates.	
Species	n
E. coli	10
Proteus spp.	3
Acinetobacter spp.	8
K. pneumoniae	9
MRSA	19
Enterobacter spp.	4
Serratia spp.	4
Enterococcus spp.	4
P. aeruginosa	6
MSSA	9

Table No. 3: susceptibility pattern of gram-positive isolates		
Antibiotics	MRSA (n=19)	
	Sensitive	Resistant
Linezolid	18	1
Ciprofloxacin	6	13
Gentamicin	6	13
Amikacin	9	10
Doxycycline	12	7
Clindamycin	17	2
Trimethoprim	6	13
Erythromycin	2	17

Discussion

The rate of neonatal deaths in developing countries is increasing annually [16]. In well-developed countries, highly technological diagnostic facilities are being used widely due to which new bacterial strains are being developed that are very difficult to control. To manage neonatal sepsis effectively, neonatologists should have a proper understanding of neonatal sepsis and its pathogenesis. They should also have current and updated information about the etiological agents that would be used and their antibiotic sensitivity profile. It is also very important to know how to select the appropriate therapy using antibiotics that will lower the rate of neonatal mortality and morbidity. During the treatment of neonatal sepsis, the most common issue is microbial resistance to antibiotics. This research focuses on those people who were diagnosed with suspected neonatal sepsis and evaluate the antimicrobial susceptibility of blood culture isolation in them. Our research confirms that progressive antimicrobial resistance is a problem in our hospital and the surrounding area for the main bacterial diseases.

Our research shows that S. aureus, E. coli, and K. pneumonia are the major microorganisms that cause neonatal sepsis which is also similar to other research studies[17]. The agents that cause neonatal sepsis vary from place to place and it also changes over time. Our research shows that E. coli was the most commonly isolated among gram-negative organisms. On the other hand, our research also shows that S. aureus was the most frequent among gram-positive organisms. This is similar to past research by Shrestha et al. whose research also showed E. coli as the most frequent organism that causes neonatal sepsis[18]. It has been extensively noted that microorganisms linked to sepsis are resistant to commonly used medications. Past studies conducted by MarzbanA et al. and Aftab et al. show high levels of resistance to gentamicin which is also comparable to our research[19, 20].

Conclusion

S. aureus, E. coli, and K. pneumonia are the major microorganisms that cause neonatal sepsis. This also serves as an inspection of antimicrobial resistance. The study provides data for the hospital infection control team to use and do further research on, and it demonstrates a considerable level of resistance to first-line antibiotics used in the hospital on a regular basis.

Funding source

None

Conflict of interest

None

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