**INTRODUCTION**

Septicemia is the significant cause of morbidity and mortality in neonates and is responsible for 30-50% of total neonatal deaths each year in developing countries. It is estimated that up to 20% of neonates develop sepsis and approximately 1% die of sepsis related causes.[1] In India, according to National Perinatal Database (NNPD) 2002-03, the incidence of neonatal septicemia has been reported to be 30/1000 live births.[2] Early diagnosis and appropriate therapy of septicemia is of utmost importance to prevent morbidity and mortality.[3] The present study was undertaken to determine the bacteriological profile and their antimicrobial susceptibility pattern of prevalent pathogens isolated from the blood of septicemic neonates from Neonatal Intensive Care Unit (NICU).

**DESCRIPTION**

The study was carried out in the department of Microbiology. 180 neonates with clinical suspicion of septicemia admitted to NICU were studied bacteriologically. Blood samples of these neonates were collected with strict aseptic precautions.

1-2 ml venous blood was inoculated into blood culture bottle containing 10-20 ml of sterile tryptose phosphate broth. The samples were processed by standard bacteriological procedure.[4]

Antimicrobial susceptibility testing was performed by Kirby-Bauer disc diffusion susceptibility method in accordance to Clinical Laboratory Standards Institutes (CLSI) guidelines.[5]

Out of 180 blood samples, septicemia could be confirmed by culture in 26.6% (48 out of 180) cases. There has been a wide variation in the growth positivity obtained by blood culture over the years. A higher isolation rate of 52.6% was reported by Murty et al.[6] in 2007. A recent study by Rajendraprasad et al.[7] reported 47.5% isolation rate.

**Key words:** Antibiotic policy, Multidrug resistance, Neonatal septicemia
Out of 48 cases, 32 cases (66.7%) were of early onset septicemia (EOS — septicemia within 72 h of life) and 16 cases (33.3%) were of late onset septicemia (LOS — septicemia after 72 h of life). This clustering of 66.7% cases in first 3 days of life reflects the immaturity of immunological responses in the first few days of life. The EOS occurs due to ascending infection from infected birth canal or following rupture of membrane usually caused by Gram-negative organisms acquired after birth from human contact.[8] Movahedian et al.[9] have reported 81.5% cases of early onset neonatal septicemia.

In the present study, Gram-negative organisms predominated being responsible for 70.8% of cases of septicemia [Table 1]. A recent study conducted in Karnataka reported 70.5% of neonatal septicemia cases caused by Gram-negative isolates.[7] In the present study, Gram-negative organisms predominated being responsible for 70.8% of cases of septicemia [Table 1].

Klebsiella pneumoniae was found to be the predominant pathogen followed by Staphylococcus aureus accounting for 35.4% and 22.9% cases respectively. K. pneumoniae was reported as a predominant pathogen in NNPD Report 2002-2003[2] and by Mane et al.[10] Roy et al.[11] and Mustafa et al.[12] from India and by Iregbu et al.[13] from Nigeria.

Other Gram-negative organisms isolated were Escherichia coli, Acinetobacter spp. and Pseudomonas spp. Acinetobacter spp. causing septicemia in neonates were reported by Arora et al.[14] and Vinodkumar et al.[15] Acinetobacter poses a major problem in NICU.

S. aureus was isolated from 22.9% cases and was the next common pathogen following K. pneumoniae. S. aureus as a major pathogen of neonatal septicemia has been reported by Karthikeyan et al.[16] These findings have implications for therapy and infection control. K. pneumoniae and S. aureus can survive in the environment for a relatively long time and fairly widely distributed in the hospital environment and therefore have the potential for being transmitted from the environment to the patients through practices that breach infection control measures.[13]

An alarming finding of this study is the high proportion of organisms resistant to commonly used antibiotics [Table 1]. Resistance ranging from 50% to 73% was observed in Gram-negative isolates for co-trimoxazole, cefotaxime, ampicillin and ceftazidime.

Gram-positive isolates had shown the resistance ranging from 42% to 71% against co-trimoxazole, cefazolin, amoxyccillin and penicillin.

Predominance of K. pneumoniae as the causative agent of neonatal sepsis may be due to the selective pressure of antimicrobial agents so that resistant organisms tend to colonize and proliferate in the neonates.[8] This is true with septicemia caused by K. pneumoniae and S. aureus. In the present study, K. pneumoniae and S. aureus had exhibited multi-drug-resistance pattern. 18.1% S. aureus isolates were found to be methicillin resistant. 29.4% of the K. pneumoniae isolates and 25% E. coli isolates were ESBL producers. It would therefore appear that the choice of drug for empiric treatment of suspected neonatal septicemia is likely to be difficult in the presence of MRSA and ESBL producers which often fail to achieve therapeutic goals even after showing in vitro susceptibility.

Maximum sensitivity for ciprofloxacin and amikacin was exhibited not only by K. pneumoniae but even by rest of the Gram-negative isolates and Gram-positive isolates. This implicates that these two antibiotics can be included as empirical therapy for neonatal sepsis. This has been corroborated by many other workers.[7,10,12,16-18]

| Table 1: Bacteriological profile of EOS and LOS cases and antimicrobial resistance pattern for Gram-negative and Gram-positive isolates |
|---------------------------------------------------------------|
| **Organisms isolated**                                      | **Antimicrobial resistance percentages** |
|                                                             | **Amk (n = 32)** | **Amp (n = 32)** | **Cefta (n = 32)** | **Cip (n = 32)** | **Co-T (n = 32)** | **Gen (n = 32)** | **Imp (n = 32)** | **Car (n = 32)** | **Pip (n = 32)** | **Mer (n = 32)** |
| **Gram-negative isolates**                                  |                 |                  |                   |                  |                  |                  |                  |                  |                  |                  |
| Klebsiella pneumoniae                                       | 12 (37.5)       | 5 (15.6)         | 17 (53.1)         |                   |                  |                  |                  |                  |                  |                  |
| Escherichia coli                                            | 5 (15.6)        | 3 (18.7)         | 8 (16.7)          |                   |                  |                  |                  |                  |                  |                  |
| Acinetobacter spp.                                          | 3 (9.4)         | 2 (12.5)         | 5 (10.4)          |                   |                  |                  |                  |                  |                  |                  |
| Pseudomonas spp                                              | 2 (6.2)         | 2 (12.5)         | 4 (8.3)           |                   |                  |                  |                  |                  |                  |                  |
| Total                                                        | 22 (66.7)       | 12 (75)          | 34 (70.8)         |                   |                  |                  |                  |                  |                  |                  |
| **Gram-positive isolates**                                  |                 |                  |                   |                  |                  |                  |                  |                  |                  |                  |
| Staphylococcus aureus                                       | 8 (25)          | 3 (18.7)         | 11 (22.9)         |                   |                  |                  |                  |                  |                  |                  |
| CONS                                                         | 2 (6.3)         | 1 (6.3)          | 3 (6.3)           |                   |                  |                  |                  |                  |                  |                  |
| Total                                                        | 10 (31.3)       | 4 (12.5)         | 14 (29.2)         |                   |                  |                  |                  |                  |                  |                  |

CONS: Coagulase-negative staphylococcus, Amk: Amikacin, Amp: Ampicillin, Cefo: Cefotaxime, Cip: Ciprofloxacin, Co-T: Cotrimoxazole, Gen: Gentamicin, Imp: Imipenem, Car: Carbenicillin, Pip: Piperacillin, Mer: Meropenem, Amox: Amoxycillin, Cz: Cefazolin, Pen: Penicillin, Van: Vanomycin, Teico: Teicoplanin
Vancomycin remains the drug of choice for MRSA strains in our set up.

Not a single Gram-negative isolate was resistant to imipenem. This indicates the absence of selective pressure since the drug is rarely prescribed.

CONCLUSION

This study concludes that empiric therapy for suspected neonatal septicemia should cover both Gram-negative bacilli and Gram-positive cocci particularly Klebsiella pneumoniae and Staphylococcus aureus. Ciprofloxacin and Amikacin, these two antibiotics can be included as empirical therapy for neonatal septicemia. An effective infection-control programme, regular antibiotic susceptibility surveillance and evaluation, and the enforcement and periodic review of the antibiotic policy of the hospital as well as the encouragement of rational antibiotic use will reduce the rates of acquiring nosocomial infections and development of bacterial resistance.

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