Susceptibility Pattern of Blood Stream Infections in Neonatal Sepsis: Striking Alarm in Era of Antibiotic Resistance

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ABSTRACT

Neonatal blood stream infections are significantly associated with increased morbidity and mortality in the recent years. In this study, we aim to determine the bacteriological profile and antibiotic susceptibility pattern of culture positive neonatal sepsis in the NICU of a tertiary teaching hospital in Kolkata. This retrospective study was conducted in the Department of Microbiology of a tertiary care teaching hospital in Kolkata between August, 2020 to July, 2021. All the neonates [both inborn / out born] admitted to NICU with the clinical diagnosis of sepsis during the specified period were screened for BSI. The blood was cultured in BACTAlert and analysed by VITEK 2. Out of 200 neonates with sepsis, 30 had culture positive sepsis of which 60% were Gram positive, rest were Gram negative. *Staphylococcus aureus* and Coagulase negative Staphylococcus (CoNS) were predominant (35.2%), *Klebsiella* was the predominant Gram negative organisms. Babies with birth weight ≤ 2 kg and gestational age 33 to 37 weeks were affected. Mortality was seen in 36.3% babies. Significant proportion of multidrug resistant isolates posed a great threat to neonatal survival. Hence modification of therapy based on anti-microbial surveillance pattern of the Institution with implementation of proper escalation and de-escalation of therapy is warranted.

1. INTRODUCTION

Septicemia is among the most severe infection usually defined by a positive blood culture and systemic clinical signs. In the absence of consensus of specific diagnostic criteria, blood culture is considered to establish the diagnosis. Neonatal blood stream infections are significantly associated with increased morbidity and mortality in NICU. In the recent year's antimicrobial resistant bacteria is an increasing problem in NICU accounting for higher mortality among neonates. Diagnosis of the blood stream infections in neonates is usually difficult due to minimal symptoms at presentation; thus early empirical therapy guided by local antibiotic susceptibility profile is necessary to improve therapeutic outcomes. The bacteriological profile and susceptibility pattern varies from region to region and is different in every hospital setting.[1] Numerous factors such as lack of antenatal care, unhygienic and unsafe delivery practices, and prematurity and low birth weight also contribute to the high morbidity and mortality.[2] Neonatal sepsis is a life-threatening clinical emergency that demands urgent diagnosis and treatment.

This study aims to determine the incidence and pattern of blood stream infection, susceptibility coverage of the recommended empirical antibiotics and to determine its impact on hospitalization, mortality and morbidity.

2. MATERIAL AND METHODS

After obtaining Institutional Ethical clearance, this retrospective study was done in the Department of Microbiology of a tertiary care teaching hospital in Kolkata. All babies admitted to the NICU (both in born and out born) between August 2020 to July 2021 were included in the study. All the babies with clinical diagnosis of sepsis were subjected to blood culture. *Blood collection was done in BacT/ALERT PF plus bottles which further used with the BacT/ALERT Microbial Detection System in qualitative procedure for recovery and detection of aerobic and facultative anaerobic microorganisms (bacteria and yeast) from blood.* The VITEK was used for fast, accurate microbial identification, and antibiotic susceptibility testing. The isolation of the causative organism and subsequent culture sensitivity was done by VITEK 2. Patient's demographic details, clinical history, bacteriological profile and antibiotic sensitivity were studied. The pattern of antibiotic resistance was also studied for the identified organisms.

3. RESULT

Out of 200 neonates admitted to NICU with clinical diagnosis of sepsis, 30 (15%) had culture positive sepsis. Of them, 60% isolates were Gram positive organisms, rest were Gram negative organisms (Fig1).
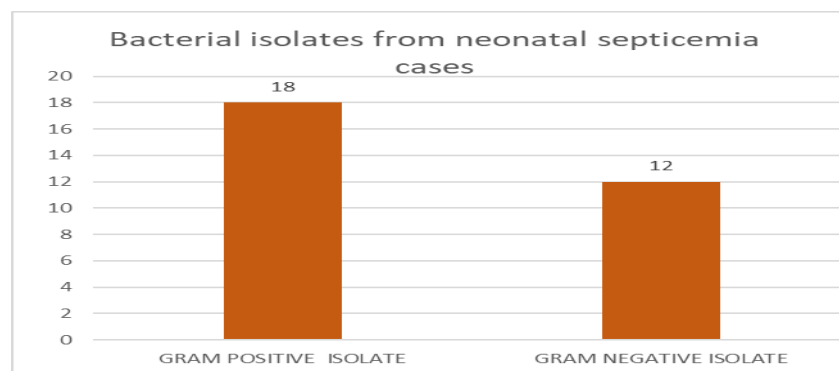

Figure I: Bacterial isolates from neonatal septicaemia cases

The most common Gram-positive isolates were both *Staphylococcus aureus* 6/30 (20%) and Methicillin resistant CoNS 6/30 (20%). Among Gram negatives, *Klebsiella* spp 5/30 (16%) was the most isolated organism followed by *Escherichia coli* 3/30 (10%) *and Acinetobacter baumannii* 3/30 (10%) (Fig2).
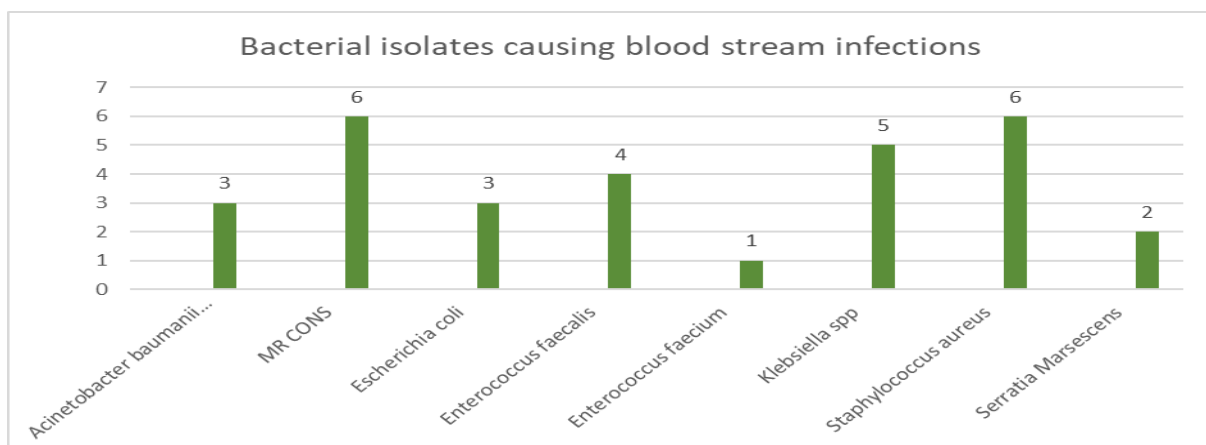

Figure 2: Different bacterial isolates causing blood stream infections

Staphylococcus showed high resistance to Cefoxitin (83%) & Erythromycin (83%) but showed good susceptibility to Linezolid, Daptomycin and Tigecycline (Fig 3).
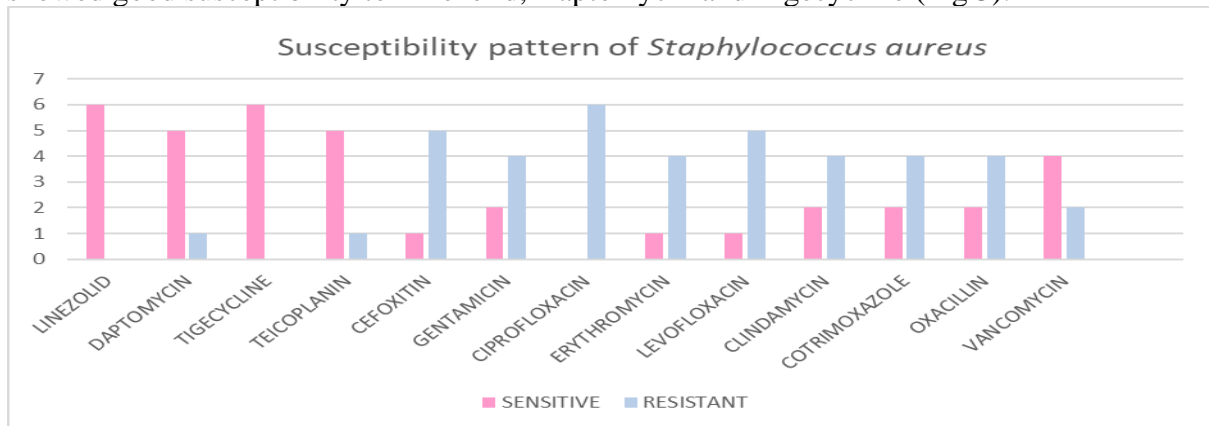

Figure 3: Susceptibility pattern of *Staphylococcal* isolates

The isolated CoNS were all resistant towards Cefoxitin and 100% sensitive to Tigecycline and Linezolid, Daptomycin, Tigecycline and Teicoplanin (Fig4).
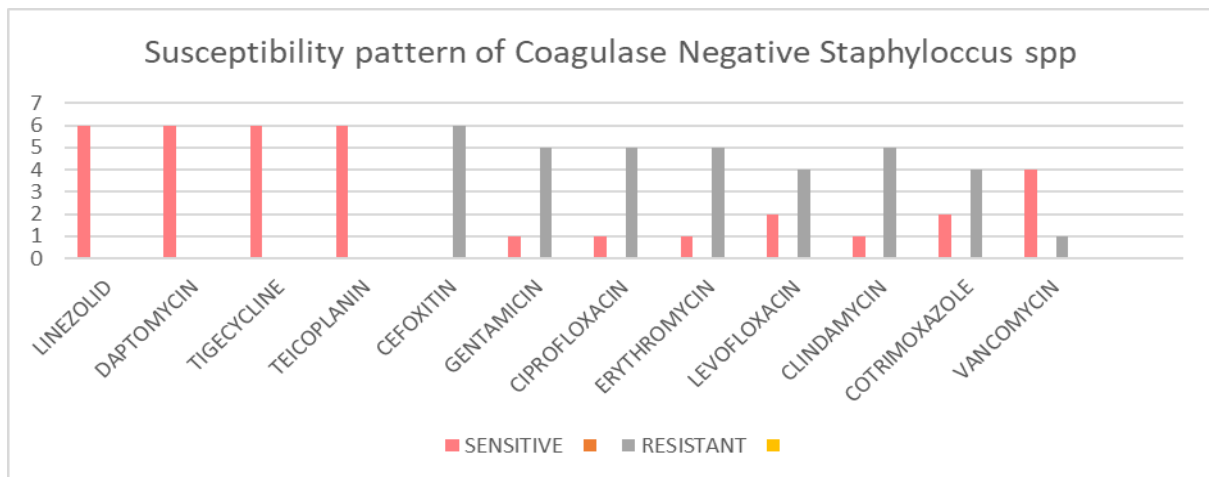

Figure 4: Susceptibility pattern of CoNS isolates

Klebsiella spp showed 100% sensitivity to Tigecycline and all were resistant to Amoxycillin (Fig 5).
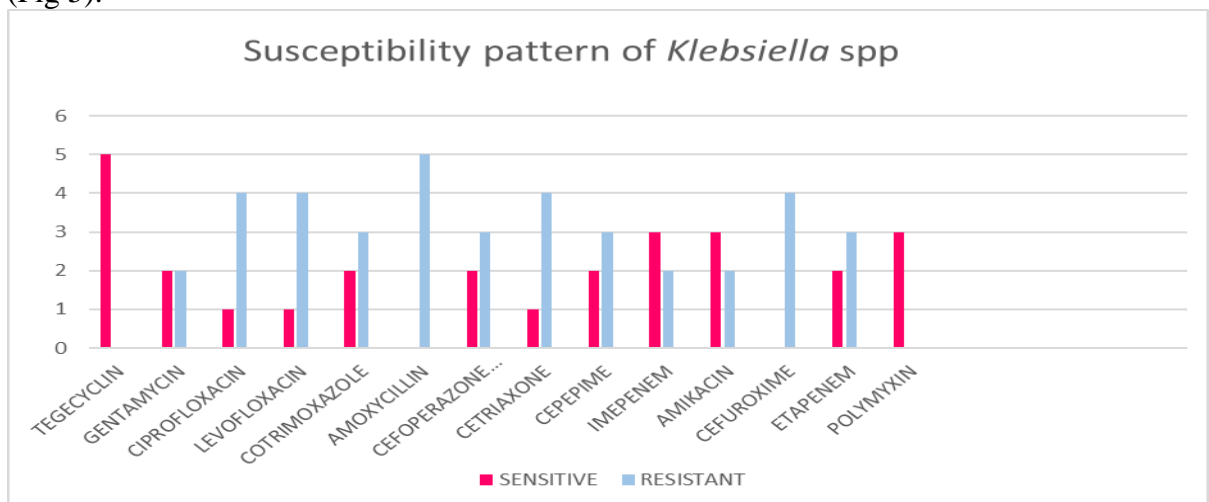

Figure 5: Susceptibility pattern of *Klebsiella* isolates

Babies with birth weight ≤ 2kg and gestational age 33 weeks to 37 weeks were affected (Fig 6 & 7).
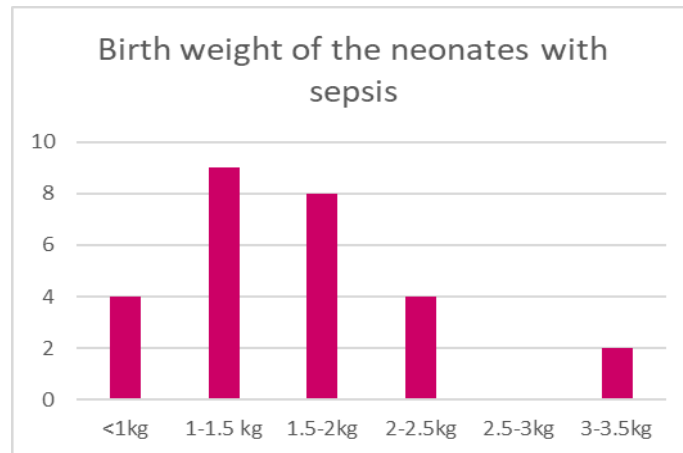

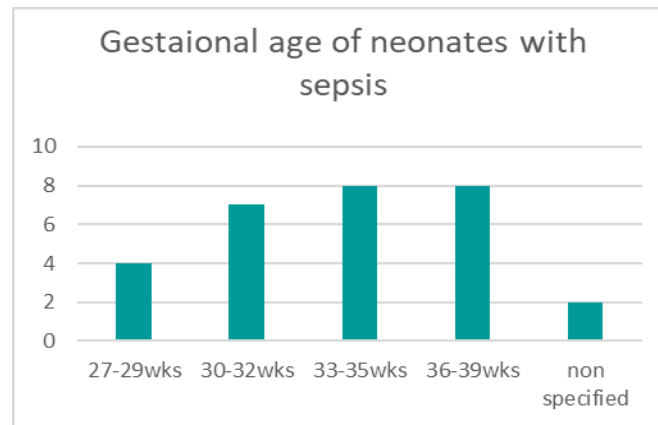**Figure 6: Birth weight of the neonates with sepsis**

Figure 7: Gestational age of neonates with sepsis

Mortality was seen in 36.3% babies with neonatal sepsis and rest showed favourable outcome (Fig 8).
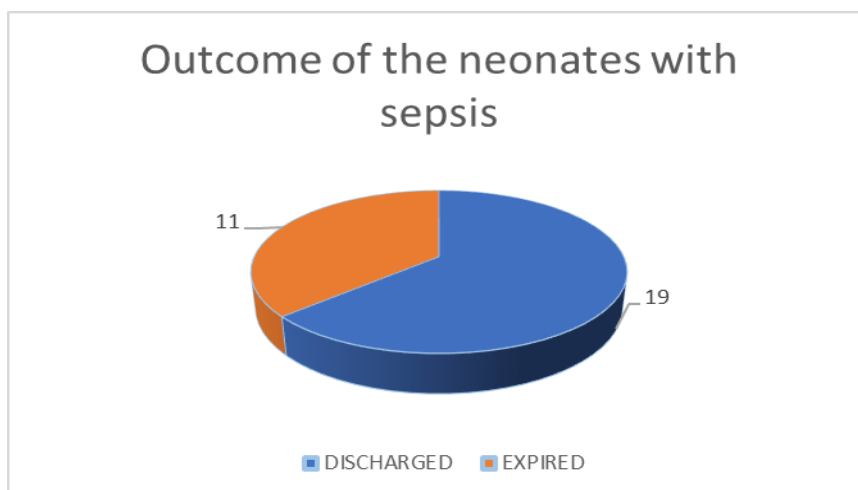

Figure 8: Outcome of the neonates with sepsis

DISCUSSION

Neonatal sepsis is the leading cause of morbidity and mortality among neonates throughout the world. According to study conducted by Shrestha S in 2007 and 2010 the prevalence of culture positive neonatal

sepsis was 13.7% and 19.56% which is similar to our prevalence of 15%.[3,4] In some studies, the prevalence of culture positive sepsis was extremely high ranging from 44.9- 48%.[5,6] According to a study conducted by Nikita et al 16.9% had microbiologically confirmed sepsis similar to our prevalence. [7] According to another study by Pawan kumar et al culture positive sepsis rate was 26% which was higher than our study prevalence.[8]

The majority of isolates in our study were Gram positive; *Staphylococcus aureus* and CoNS. This was concordant with study conducted by Peterside O. et al in Nigeria and Sharma P et al in India. [9,10] Here, *Staphylococcus aureus* was the predominant Gram positive isolate. [10] In a study by Pawan Kumar et al. common isolates were *Staphylococcus aureus* and *Klebsiella* species.[8] Bacterial profile revealed the highest prevalence of *S. aureus* followed by *K. pneumoniae* as per the study by Nikita et al.[7] CoNS have been reported in various studies as the most common cause of neonatal sepsis in NICUs. [11]

These bacterial strains are predominant causative agents which have been identified by several studies. [6, 12-14] *Klebsiella* species were the most frequent causative organisms of neonatal sepsis in our study, a similar finding to that of Shrestha S et al. [14]

Among Gram-negative isolates, *K. pneumoniae* accounts the highest which causes infection in neonates. This finding was similar with previous studies conducted among neonates.[15,16] Our study shows the majority of causative organisms have developed resistance to these frequently used antibiotics. Among Gram positives *Staphylococcus aureus*, Methicillin resistance was seen 83% of the isolates. It was also resistant to fluroquinolones and co-trimoxazole. Vancomycin and Linezolid showed high susceptibility towards Gram-positive isolates, similar to the findings of Mullah SA et al. and Singh HK.[17,18]

Positive blood culture was observed high (62.7%) in low birth weight neonates in a study by Nikita et al which is similar to our

study.[7] The low birth weight is strong risk factor that leads to neonatal sepsis as found in the study by Nikita et al.[7] The same study showed highest infection among preterm neonates compared to term neonates. This is contradictory to our study where the maximum cases of neonatal sepsis were the babies with gestational age between 35-39 weeks. Infection with CoNS is usually associated with the use of interventions, such as central vascular catheter. According to a study by Aravanan Anbu et al maximum prevalence of neonatal sepsis was seen in the low birth weight babies with body weight ranging from 1kg to 1.5 kg.[2]

4. CONCLUSION

Most common isolates in our study were *Staphylococcus aureus* and Coagulase negative *Staphylococcus* among Gram positive organisms and *Klebsiella pneumoniae* was the most common detected Gram negative isolate. Both Gram positive and Gram negative isolates detected high resistance to commonly used antibiotics, posing a great challenge for the treatment. The antibiotic sensitivity pattern provides an insight for the selection of antibiotics. To prevent the development of antibiotic resistance, proper hand hygiene and other methods of asepsis should be practised in NICU, proper selection of empirical antibiotics while awaiting for blood culture report and judicial escalation and timely de-escalation should be practiced.

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