



Original Research Article

Bacteriology of neonatal septicemias in a tertiary care hospital

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ARTICLE INFO

Article history:

Received 27-01-2020

Accepted 30-01-2020

Available online 08-04-2020

Keywords:

Neonatal sepsis

Blood culture

Gram negative bacilli

CONS

Drug sensitivity

ABSTRACT

Introduction: Neonatal sepsis is the second leading cause of mortality with an annual toll of more than one million deaths of the newborn. The incidence and subsequent risk factors in the clinical management of newborn sepsis is a continuing major global public health concern. Although variety of sepsis screening methods available, blood culture and sensitivity is considered as the most promising test for diagnosis of neonatal septicemia because, the type of microorganisms associated and their antibiotic sensitivity pattern vary significantly.

Materials and Methods: A retrospective analysis of blood cultures was carried out in the department of microbiology, SVS medical college, Mahabubnagar, Telangana for the period of June 2017 to October 2019. Blood cultures (in BacT/Alert, biomerieux) were incubated and growth was identified as per the standard protocols. Antibiotic sensitivity testing of the isolates was performed in VITEK 2-compact (biomerieux).

Results: From a total of 210 positive samples, the incidence of Gram negative bacilli predominates (65.2%) the Gram positive cocci (34.8%). Klebsiella species (94 out of 137) and coagulase negative Staphylococci (61 out of 73) are the most predominant bacteria isolated from neonatal sepsis. Antibiotic sensitivity pattern of the isolates varies significantly. However, most widely used carbapenems and cephalosporins demonstrated only marginal efficacy towards enteric GNB.

Conclusion: Surveillance for emerging MDR pathogens is essential to monitor changing epidemiological trends to guide optimum empirical therapy.

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1. Introduction

Neonatal sepsis is the second leading cause of mortality with an annual toll of more than one million deaths of the newborn.¹ India has the highest incidence of clinical sepsis (17000/100,000 live births) compared to the global scenario (2202/100,000 live births) with case fatality ranging from 25% to 65%.^{2,3} Though, it is classified as early onset and late onset type with diverse etiology, the incidence and subsequent risk factors in the clinical management of newborn sepsis is a continuing major global public health concern. The known risk factors for neonatal sepsis are male gender, out born admissions, need for artificial ventilation and the maternal factors such as, gestational age <37 weeks

and premature rupture of membranes are also known to increase the risk.⁴ Immature immune system and poorly developed skin and other mucosal barrier mechanisms are additional contributing factors for microbial colonization and invasion.

The type of microorganisms associated and their antibiotic sensitivity pattern may vary significantly based on the geographical location. Although, bacterial agents predominate in the etiology of neonatal sepsis; however, the emergence of *Candida albicans* including non *albicans* *Candida* species is on rise.⁵ Members of the enterobacteriaceae family are predominantly reported from neonatal blood cultures and the incidence of non-fermenting Gram negative bacilli (GNB) are also being reported significantly, possibly because of automation in diagnostic microbiology

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laboratories aids in the precise identification of diverse microbial agents. Biochemical markers and risk factor based approach for early prediction and diagnosis of neonatal sepsis have been described as highly effective,⁶ however, clinical failures are being observed frequently due to emergence of drug resistant pathogens. Therefore, in spite of known limitations, blood culture and sensitivity is still considered as the most promising test for diagnosis of neonatal septicemia because of the guidance it provides on antimicrobial sensitivity. A thorough understanding of recent epidemiological trends and microbial characteristics are useful for implementation of sepsis preventive and clinical management strategies. Therefore, the present study aims at highlighting the predominant organisms causing neonatal sepsis in a tertiary care hospital and their antibiotic susceptibility pattern is very essential to select optimum empirical treatment.

2. Materials and Methods

This retrospective study was performed in the department of microbiology, SVS medical college, Mahabubnagar, Telangana for the period of June 2017 to October 2019. Blood samples (in BacT/Alert PF plus, biomerieux) from suspected neonatal sepsis cases admitted at SVS medical college hospital were sent to the department of microbiology for culture and sensitivity. They were incubated at 37°C in BacT/Alert instrument and specimens with growth indication were subcultured on blood agar and MacConkey agar and growth was identified as per the standard protocols. Antibiotic sensitivity testing was performed in VITEK 2-compact (biomerieux) using VITEK® 2 AST-P628, N280 and N281 for Gram positive cocci, Gram negative enteric bacilli and non-fermenting GNB respectively.

3. Results

Out of 726 samples analyzed, significant bacterial growth was obtained in 210 samples (28.9%), while remaining samples were found to be negative (71.1%). Total number of isolates and their distribution according to the age and sex were shown in Table 1. Overall, the incidence of Gram negative bacilli predominates (137; 65.2%) the Gram positive cocci (73; 34.8%) in the etiology of neonatal sepsis in our study. The incidence of GPC in early onset (<3days) and late onset (>3days) sepsis was found to be at 41.1% and 58.9%; while the incidence of GNB for the similar scenario was found to have only marginal difference i.e. 52.6% and 47.4% respectively. Similarly, gender related difference was not significant in the etiology of neonatal sepsis.

The different bacterial species isolated and their antibiotic sensitivity pattern (%) were shown in Table 2. Coagulase negative staphylococci (CONS) is the leading cause of sepsis (61; 83.6%) followed by *Staphylococcus*

aureus (10; 13.7%) among the GPC. In Gram negative bacilli, *Klebsiella* species are the most predominant bacteria isolated (94; 68.6%) followed by *Acinetobacter* species and *Pseudomonas aeruginosa* at parallel frequency (9; 6.6%). The remaining minor proportion (6, 4.4%) of cases were caused by *E. coli* and *Enterobacter* species. Although infrequent, additional bacteria with significant clinical importance isolated include, *Burkholderia cepacia*, *Achromobacter* species, *Elizabethkingia meningoseptica*, *Brevundimonas diminuta* and *Sphingobacterium spiritivorum*.

Antimicrobials such as, linezolid, tigecyclin, vancomycin, teicoplanin, daptomycin and tetracyclin were most effective against both types of Staphylococci, while most of the enteric GNB (*Klebsiella*, *E. coli* and *Enterobacter*) were highly susceptible towards colistin, tigecyclin, amikacin, gentamycin and cotrimoxazole. Cephalosporins and carbapenems such as, imipenem and meropenem are most widely used antibiotics in current clinical practice were found to exert only marginal antimicrobial efficacy towards enteric GNB. However, non-fermenting GNB such as, *Acinetobacter* and *Pseudomonas* showed moderate susceptibility towards majority of tested antimicrobials.

4. Discussion

The incidence of group B Streptococci has been gradually decreased possibly due to improved obstetric care and use of intrapartum antibiotic prophylaxis,⁷ while the occurrence of neonatal sepsis due to CONS and GNB proportionately raised. In spite of low virulence, CONS is able to exert long term detrimental effects following sepsis in the immature and low birth weight new born.⁸ The ability of CONS to readily acquire pathogenic determinants such as, biofilm formation, antibiotic resistance and adaptation to nosocomial environment, underscores its clinical significance.⁹ In addition, they were only moderately sensitive to gentamicin, while most of the GNB were highly susceptible, since current guidelines for empirical therapy in neonatal sepsis recommends gentamicin in combination with ampicillin.

Carbapenemase production in GNB could be the reason for diminished efficacy of imipenem and meropenem against *Klebsiella* isolates as shown in Table 2. It is the most predominant bacteria known for carbapenemase production, however the magnitude of its prevalence varies across regions and proportionate to the use of carbapenems.¹⁰ Extensive use of these antibiotics in current clinical practice is largely responsible for rapid emergence and dissemination of MDRGNB, consequently increasing the frequency and mortality of neonatal sepsis. Cephalosporins also demonstrated least spectrum of activity against *Klebsiella* and other enteric GNB isolates in this study possibly due to ESBL production, therefore utility of cephalosporins for empirical antibiotic therapy should be cautiously exercised.

Table 1: Age and sex wise distribution of organisms

Organism	No of isolates	Age <3days	>3days	Sex Male	Female
Gram positive cocci	73	30 (41.1%)	43 (58.9%)	38 (52.1%)	35 (47.9%)
Gram negative bacilli	137	72 (52.6%)	65 (47.4%)	67 (48.9%)	70 (51.1%)

Table 2: Organisms isolated and antibiotic sensitivity pattern (%)

Gram positive bacteria	No of isolates	CD	LZ	DM	TEI	VA	TE	GEN	LE	CIP	TGC	RIF	TRS
CONS	61	21.7	94.2	76.8	88.4	91.3	81.1	44.3	14.5	13	98.5	73.9	58
Staphylococcus aureus	10	0	100	90	90	90	80	50	0	0	100	70	80
Enterococcus spp	1	100			100	100	100	100*	100	100	100		
Streptococcus pneumoniae	1	100	100			100			0		0	100	0
Total	73												
Gram negative bacteria		PIT	CAZ	CFS	CPM	IPM	MRP	AK	GEN	CIP	TGC	CL	TRS
Klebsiella spp	94	26.6	13.8	26.6	24.5	26.6	27.6	81.9	80.8	57.4	78.7	91.5	89.4
Acinetobacter spp	9	44.4	55.5	66.7	66.7	66.7	66.7	66.7	66.7	55.5	100	100	66.7
Pseudomonas aeruginosa	9	55.5	66.7	66.7	22.2	66.7	88.9	55.5	44.4	55.5	11.1	22.2	33.3
E coli	6	50	16.7	50	33.3	50	50	83.3	50	33.3	100	66.7	16.7
Enterobacter spp	6	33.3	16.7	33.3	16.7	33.3	33.3	66.7	83.3	83.3	100	100	83.3
Burkholderia cepacia	4	0	100	0	25	0	75	0	0	25	0	0	25
Citrobacter spp	2	0	0	0	0	0	0	100	100	100	100	100	100
Achromobacter spp	2	50	50	100	0	0	50	0	0	0	100	50	50
Serratia marcescens	2		100	100	100	100	100	100	100	100	100	0	100
Elizabethkingia meningoseptica	1	0	0	100	0	0	0	0	0	100	100	0	100
Brevundimonas diminuta	1	100		100	100	100	100	0	0	0	100	0	0
Sphingobacterium spiritivorum	1	0	0	0	0	0	0	0	0	0	0	0	100
Total	137												

CD-Clindamycin; LZ- Linezolid; DM-Daptomycin; TEI-Teicoplanin; VA-Vancomycin; TE-Tetracycline; GEN-Gentamicin; LE-Levofloxacin; CIP-Ciprofloxacin; TGC-Tigecycline; RIF-Rifampicin; TRS-Cotrimoxazole; PIT-Piperacillin/Tazobactam; CAZ-Ceftazidime; CFS-Cefoperazone/Sulbactam; CPM-Cefepime; IPM-Imipenem; MRP-Meropenem; AK-Amikacin; CL-Colistin; *High level gentamicin

In our study no significant differences in the incidence of newborn sepsis were observed between male and female patients, since male disadvantage hypothesis¹¹ corroborates that new born males are more sensitive to adverse perinatal and postnatal environmental conditions, as they are likely to be born preterm and with low birth weight¹² in addition to their need for initial respiratory support¹³ all of which increases the risk of neonatal sepsis.

5. Conclusion

The present study highlights the importance of blood culture and sensitivity not only for diagnosis of neonatal sepsis, nonetheless it is essential to monitor changing epidemiological trends to guide optimum empirical therapy and implementation of infection control policies.

6. Acknowledgements

The authors thank S.V. S Medical College, Telangana for their essential support.

7. Source of Funding

None.

8. Conflicts of Interest

None.

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Cite this article: Priya MN, Vamsi KS, Singh M, Kabra V, Reddy YRR. **Bacteriology of neonatal septicemias in a tertiary care hospital.** *Indian J Microbiol Res* 2020;7(1):35-38.