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Original Research Article

Microbial Profile of Neonatal Sepsis and its Antibiogram Prevalent in a Tertiary Care Hospital

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Abstract:

Objectives: The infection of the bloodstream in newborn babies younger than 28 days is referred to as neonatal sepsis. Blood cultures are an essential diagnostic tool for certain illnesses and antibiotic susceptibility patterns support therapeutic rationalisation. The present study was to evaluate the microbial profile of neonatal septicemia and its antibiogram prevalent and sensitivity pattern in a tertiary care hospital.

Methods: A total of 178 neonates with clinical sign of sepsis were enrolled. All the clinical assessment and investigation including specimen collection, culture, identification of isolates and antibiotic sensitivity testing were performed. The antimicrobial sensitivity testing was done for all pure bacterial isolates in Mueller- Hinton agar plate by using Kirby-Bauer disk diffusion technique.

Results: Out of 178 new born with clinical sepsis, blood culture were positive in 110(61.79%) cases. 79.06% had EOS and 20.91% had LOS. Majorities of newborn were males 63.64%. 60.91% had low birth weight <2500 gram. 59.09% had gestational age <37 weeks. Out of 77 pathogenic bacteria, klebsiella pneumoniae (35.06%, Staphylococcus aureus 28.57% and Escherichia coli (16.88%) were the most common isolates. Out of 33 pathogenic candida, Candida tropicalis (36.36%) and Candida kruzei (21.21%) were the most common. In the gram-negative isolates, the highest sensitivity was reported for Amikacin (100%), Colistin (100%), Imipenem (95.74%), followed by Gentamicin (82.98%). Highest resistance was seen in ampicillin (100%). In gram-positive isolates, the highest sensitivity was reported for Vancomycin (100%), Teicoplanin (100%), Linezolid (92.85%) followed by gentamicin (89.28%), and Amoxicillin/clavulanic acid (67.85%).

Conclusion: Most common risk factors of neonatal sepsis are low birth weight and preterm labour. Most common pathogens isolates are klebsiella pneumoniae, Staphylococcus aureus, Escherichia coli and Candida tropicalis. Amikacin, colistin and imipenem are the highest sensitivity for gram negative isolates. Vancomycin, teicoplanin, linezolid are the highest sensitivity for gram positive isolates. The success of therapy is essentially dependent on early diagnosis and initiation of appropriate antibiotics. Hence, blood culture is a Gold Standard for diagnosis of neonatal sepsis.

Keywords: Neonatal Sepsis, Prevalent, Antibiogram, Sensitivity Pattern.

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Introduction

Sepsis is a dysregulated host response to infection leading to life-threatening organ dysfunction [1]. The infection of the bloodstream in newborn babies younger than 28 days is referred to as neonatal sepsis. In developing and underdeveloped nations, it continues to be a significant factor in neonatal morbidity and mortality [2].

It is classified in two categories on the basis of epidemiology and time of onset. The infection which manifests within first 72 hours of life is termed as early-onset neonatal sepsis (EONS), while late onset neonatal sepsis (LONS) is considered if the features of sepsis appear after 72 hours [3]. Neonatal sepsis continues to be a challenging scenario to paediatricians in developing as well as developed countries. It accounts for a significant proportion of neonatal mortality and morbidity. In India 16.4% neonatal death is associated with neonatal sepsis [4]. Although neonatal sepsis is essentially a systemic infection, the spectrum of sepsis in neonate can vary from subclinical disease to severe systemic infection. The signs of neonatal sepsis viz. Irritability, hyperpyrexia or hypothermia, lethargy,

poor feeding, poor perfusion, hypotension, tachycardia, respiratory distress, jaundice are vague and non-specific [5]. Although isolation of bacterial pathogen in culture from blood is the gold standard, a majority of these patients remain culture-negative. A negative culture is not an adequate criteria to rule out infection. Furthermore, there is a lack of sensitive markers for diagnostic purpose and the diagnosis is often relied on clinical suspicion [6].

The gold standard for the diagnosis of neonatal sepsis is isolation of bacterial agents from the blood culture [7]. Both gram negative and gram positive bacteria have been isolated from the blood and predominance of one type over the other varies from place to place and even in the same place over the time to time [8]. In most of the developing countries, gram negative sepsis remains the major cause of the neonatal septicemia. Commonly isolated organisms include Klebsiella Pneumonia, Escherichia Coli, Enterobacilli, Pseudomonas Aeroginosa, Staphylococcus Aureus, Streptococcal Species, Citrobacter Species and Coagulase Negative Staphylococcus (CONS) [9, 10]. The bacterial susceptibility to different antibiotics varies from time to time over different geographical areas. But there is a rising concern of isolation of highly antibiotic resistant bacteria [11].

Blood cultures are an essential diagnostic tool for certain illnesses and antibiotic susceptibility patterns support therapeutic rationalisation. Prevalent bacterial agents and their antibiotic responsiveness usually vary with the geographical place and time [11]. Hence, regular monitoring of the prevalence of bacterial pathogens and their trend in antibiotic resistance patterns is essential to maintain the appropriate antibiotic policy and thereby better patient management. Objective of the present study was to evaluate the microbial profile of neonatal sepsis and its antibiogram prevalent in a tertiary care hospital of Bihar.

Material & Methods

The present study was conducted in the Department of Pediatrics, Government Medical College, Haridwar, Uttarakhand, India during a period from October 2025 to February 2026.

Study Group: The study group comprised 178 neonates admitted to Neonatal Intensive Care Unit with clinical signs of septicemia.

Inclusion Criteria: All the neonates who were admitted with clinical signs of Sepsis.

Exclusion Criteria: Neonates born to mothers who had received Antenatal Antibiotic Therapy within 48 hours prior to delivery and symptomatic neonates who had been started on antibiotics. The diagnosis of Neonatal Septicemia was based on clinical criteria like poor activity, lethargy, inability or poor sucking, hypothermia, abdominal distension, and diminished or absent Neonatal Reflexes. Media preparation: Brain Heart Infusion Biphasic Media (BHIBPM) culture bottles were used for performing Blood Culture.

Specimen collection and Transport: Any peripheral vein was chosen as the venepuncture site. The site was cleaned and disinfected with povidoneiodine followed by 70% Isopropyl alcohol and allowed to dry. Two millilitres of blood was collected with the help of a sterile disposable scalp vein (24G) and syringe (2 ml.) and immediately transferred to BHIBPM. Then the bottles were shaken gently to mix the blood with the broth homogeneously and transferred to the Microbiology laboratory in an upright position for incubation and culture [12].

Culture: In the laboratory the, bottles were incubated at 37°C for a maximum period of 7 days. The bottles were observed daily for signs of growth like turbidity, air bubbles and colonies on the surface of the sedimented red cells or over the solid slant portion of the biphasic medium. As soon as growth was observed, subculture was done on Blood agar and CLED agar plates and incubated at 37°C [13]. The bottles that showed no growth for 7 days were discarded.

Identification: Isolates were identified by their characteristic appearance on the respective media, Gram staining, and confirmed using standard biochemical tests [13]. For Gram-positive bacteria catalase, coagulase bile aesculin and other tests were performed. Gram-negative isolates were identified by motility test, indole production, citrate utilization, oxidase, sugar fermentation, and other tests. In the case of Candida isolates first Germ tube test was done to differentiate Candida albicans from Nonalbicans. Carbohydrate Assimilation and Carbohydrate Fermentation test was done for further speciation [14].

Antibiotic Sensitivity Testing: The antimicrobial sensitivity testing was done for all pure bacterial isolates in Mueller- Hinton agar plate by using Kirby-Bauer disk diffusion technique. The sensitivity pattern was studied depending on the zone of inhibition as per the standard CLSI guidelines [15].

The antibiotic discs used in the study were: Ampicillin (10µg), Amikacin (30µg), Amoxycillin/ Clavulanic acid (20/10µg), Ciprofloxacin (5µg), Cefuroxime (30µg), Cefotaxime (30µg), Cefoxitin (30µg), Colistin (10µg), Gentamicin (10µg), Imipenem(10µg), Linezolid (30µg), Piperacillin/ Tazobactam (100/10µg), Teicoplanin (30µg), Vancomycin (30µg).

Statistical Analysis: Data was analysed by using simple statistical methods with the help of MS-

office software. All data was tabulated and percentages were calculated.

Results

A total of 178 new born clinical sepsis was admitted. Among them, blood culture were positive in 110 cases (61.79%). Out of 110 positive cases 87(79.09%) had EOS. 23(20.91%) had LOS. Majorities of newborn were males 70(63.64%). Male and female ratio was 1.75. Majorities of sepsis newborn 67(60.91%) had low birth weight <2500 gram.

Table 1: Age at onset of Septicaemia in neonates of both sexes

Age at onset of sepsis	Total number of cases (%)	Number of male babies	Number of female babies
0-3 days (EOS)	87(79.09%)	55(78.57%)	32(80%)
4-28 days(LOS)	23(20.91%)	15(21.43%)	8(20%)
Total	110 (100%)	70(63.64%)	40(36.36%)

Table 2:Distribution of culture-positive neonates in relation to Gestational age.

Birth weight	No. of cases	Percentage
<2500gm (LBW)	67	60.91%
>2500gm (Normal)	43	39.09s%
Total	110	100%

Most of the newborn 65(59.05%) had gestational age <37 weeks.

Table 3: Distribution of culture-positive neonates in relation to Gestational age

Gestational age in weeks	No. of cases	Percentage
<37 weeks (Preterm)	65	59.09%
>37 weeks (Term)	45	40.91%
Total	110	100%

Pathogenic bacteria were isolated in 77 cases. Among them, klebsiella pneumoniae 27(35.06%), Staphylococcus aureus 22(28.57%), Escherichia coli 13(16.88%) and Coagulase negative staphylococcus 8(10.39%) were found in majorities of cases.

Table 4: Pathogenic bacteria isolated from Blood culture

Bacteria	No. of cases	Percentage
Klebsiella pneumoniae	27	35.06%
Staphylococcus aureus	22	28.57%
Escherichia coli	13	16.88%
Coagulase negative staphylococcus	8	10.39%
Enterococcus species	3	3.89%
Serratia species	1	1.29%
Acinetobacter species	2	2.6%
Citrobacter species	1	1.29%
Total	77	70%

Pathogenic candida species was found in 33(30%) cases. Among them, Candida tropicalis, Candida kruzei, Candida albicans, Candida parapsilosis and Candida glabrata were found in 12(36.36%), 7(21.21%), 6(18.18%), 5(15.15%) and 3(9.09%) cases respectively.

Table 5: Pathogenic Candida species isolated from blood culture

Candida species	No. of cases	Percentage
Candida tropicalis	12	36.36%
Candida albicans	6	18.18%
Candida kruzei	7	21.21%
Candida parapsilosis	5	15.15%
Candida glabrata	3	9.09%
Total	33	30%

In the present study, Antibiotic susceptibility pattern was studied for all bacterial isolates causing Neonatal Sepsis. For the Gram-negative isolates, the highest sensitivity was reported for Amikacin 47(100%), Colistin 47(100%), Imipenem 45(95.74%), followed by Gentamicin 39(82.98%),

Ciprofloxacin 41(87.23%), Piperacillin/Tazobactam 38(80.85%) Amoxycillin/Clavulanic acid 21(44.68%). The highest resistance was observed to Ampicillin (100%).

Table 6:Antimicrobial sensitivity pattern of Gram negative bacilli (N=42)

Antibiotic	No. of cases	Percentage
Amikacin	47	100%
Gentamicin	39	82.98%
Cefotaxime	4	8.51%
Cefuroxime	3	6.38%
Ciprofloxacin	41	87.23%
Piperacillin/Tazobactam	38	80.85%
Amoxycillin/Clavulanic Acid	21	44.68%
Imipenem	45	95.74%
Ampicillin	0	00
Colistin	47	100%

For Gram-positive isolates, the highest sensitivity was reported for Vancomycin 28(100%), Teicoplanin 28(100%), Linezolid 26(92.85%) followed by gentamicin 25(89.28%), ciprofloxacin 20(71.43%) and Amoxicillin/clavulanic acid 19(67.85%).

Tabe 7: Antimicrobial sensitivity pattern of Gram positive isolates (N=24)

Antibiotic	No. of cases	Percentage
Gentamicin	25	89.28%
Ciprofloxacin	20	71.43%
Amoxycillin/Clavulanic Acid	19	67.85%
Cefoxitin	17	60.71%
Vancomycin	28	100%
Linezolid	26	92.85%
Teicoplanin	28	100%

Discussion

Neonatal sepsis is one of the significant life-threatening condition encountered by almost all neonates affected due to any communicable or non-communicable 1 diseases particularly during hospitalization. Various studies have reported that neonatal sepsis is a significant cause of morbidity and mortality worldwide [16,17].

Newborns are particularly susceptible to sepsis as a result of their immature immune system, the decreased phagocytic activity of their white blood cells and their incompletely developed skin barriers [18,19]. Common risk factors for neonatal sepsis in Northern India have been identified as low birth weight, perinatal asphyxia, preterm labour and premature rupture of membranes [20].

Neonatal sepsis is classified as early onset when it occurs within the first 72 hours of life and late onset when it occurs after 72 hours of life [21]. Early onset sepsis is caused by organisms prevalent in the maternal genital tract, labour room or operating theatre [22] while late onset sepsis usually results from nosocomial or community-acquired infection [23]. Among intramural births, Klebsiella pneumoniae is the most frequently isolated pathogen (32.5%), followed by Staphylococcus aureus (13.6%). Among extramural neonates (referred from community/other hospitals), Klebsiella pneumoniae is again the commonest organism (27%), followed by Staphylococcus aureus (15%) and Pseudomonas (13%) (http://www. newbornwhocc.org/pdf/nnpd_report_2002 03.pdf).

Antibiotics are the most prescribed medication in neonatal units, and their prompt initiation can be life-saving in neonatal early-onset sepsis (EOS) [24]. However, for late-preterm and full-term neonates, the incidence of EOS has decreased over the last decades [25]. Limited precision of current diagnostic tools and resulting concern of missing sepsis in conjunction with unchanged management strategies for suspected EOS are the main factors associated with antibiotic overuse in early life [13-15]].

In the present study, out of 178 clinically suspected cases of neonatal Sepsis, 110 neonates were Culture positive with a Blood Culture positivity rate of 61.79%. This finding correlates well with the study of other workers like Premlatha DE et al, 72.3% [26]. EOS culture-positive cases were 79.09% and 20.91% were LOS. A higher prevalence of EOS was also reported by another study like Galhotra S et al, [27]. The ratio of culture-positive Male to Female babies was 1.75. Similarly, Buch et al found a Male to Female ratio of 1.8:1 [28]. Several explanations had been laid down for higher male susceptibility, it may be due to a gene located on the X Chromosome involved in the synthesis of immunoglobulins in the male infants thus conferring less immunological protection compared to females [29].

In the present study, it was observed that low birth weight babies were more prone to Sepsis, observed frequency in the present study was 60.92%, comparable to the study done by Tallur SS et al, 55% [30]. The immature cellular immunity and low level of immunoglobulin (IgG), excessive handling and contaminated incubators expose them to infecting organisms, thus increasing infections rate. Second, to low birth weight, prematurity is the most important predisposing factor for Septicemia.

In the study, preterm neonates accounted for 59.09% of the cases. This coincides with, a study by Khinchi YR et al, 54.6% [31]. It has been established that several phagocytic functions are impaired including chemotaxis, phagocytosis and bacterial killing in preterm neonates. Also, there is impaired opsonic activity of the serum in pre-terms which is attributed to low levels of complement factors and partly to antibody deficiency. Stoll BJ [32].

In the present study, out of the 110 culture-positive cases, 70% were Bacteria and 30% were Fungal isolates. Similar studies done in the past by workers like R Rani et al reported 62.3% Bacterial and 37.7% Fungal agents [33]. Changing trends of higher incidence of candidemia may be due to indiscriminate use of broad spectrum antibiotics in neonatal septicemic cases.

In the present study, Klebsiella pneumonia 35.06% is most commonly isolated. This Gram-negative preponderance was also reported by Sriram R [34]. Amongst Gram positive isolates, our study reported Staphylococcus aureus (28.57%) as the most common one. This is in accordance with the study done by Agnihotri N, et al, who reported 35% as Staphylococcus aureus [35].

In the present study, out of the total 33(30%) Candida species, the highest was Candida tropicalis 36.36%. This was similar to the findings of Jain A et al, who reported Candida tropicalis as the most common isolate [36]. Regarding the Antibiotic susceptibility pattern of the Gram-negative isolates in our study: 100% sensitivity was reported for Amikacin, Colistin followed by Imipenem (95.74%). These isolates reported 100% resistance to Ampicillin. This is in concordance with the finding of other workers like Rasool KH, et al, [37]. This was mostly due to the indiscriminate use of third-generation cephalosporins. Gram-positive isolates in our study were 100% sensitive to Vancomycin, Teicoplanin and 92.85% sensitive to Linezolid. These results are very much similar to the study done by Shaw CK [38].

To avoid multidrug resistance, these medications can be used as empirical therapy, although they should be implemented with caution. Neonatal septicaemia's evolving microbial ecology is linked to considerable mortality as well as morbidity and long-term morbidity. Therefore, to guide the selection of empirical antibiotic therapy while awaiting the results of blood culture, regular periodical tracking of the neonatal sepsis-causing organisms and their patterns of antibiotic susceptibility is required [39].

Conclusion

The present study concluded that the most common risk factors of neonatal sepsis are low birth weight and preterm labour. Most common pathogens isolates are klebsiella pneumoniae, Staphylococcus aureus, Escherichia coli and Candida tropicalis. Amikacin, colistin and imipenem are the highest sensitivity for gram negative isolates. Vancomycin, teicoplanin, linezolid are the highest sensitivity for gram positive isolates. The success of therapy is essentially dependent on early diagnosis and initiation of appropriate antibiotics. Hence, blood culture is a Gold Standard for diagnosis of neonatal sepsis.

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