ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 01 | January - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MICROORGANISMS IMPLICATED IN NEOTATAL SEPSIS AND THEIR ANTIMICROBIAL SUSCEPTIBILITY IN A PART OF NORTH EAST INDIA

Neonatology

Dr Murchana Khound* Registrar Pediatrics Department, Jorhat Medical College And Hospital. *Corresponding Author

Dr Mritunjay Pao Senior Consultant, Pediatrician And Pediatric Intensivist At Sanjivani Hospital, Jorhat.

Dr Sekharjyoti Sharma Consultant, Anaesthesiologist At Sanjivani Hospital, Jorhat.

ABSTRACT

BACKGROUND: Neonatal sepsis is the leading cause of newborn mortality and morbidity worldwide. The spectrum of microorganisms shows wide variation in different regions of the world and also in different hospitals of the same region. In this study we have tried to find out the common bacterial organisms causing neonatal sepsis in our region and their antibiotic susceptibility. **METHOD:** It is a hospital based observational study conducted in one of the busiest hospitals of Jorhat over a period of 18 months. Blood culture reports of all patients were traced from the hospital laboratory data. Positive culture reports for bacterial sepsis were studied and analysed statistically. **RESULT:** Total 602 blood cultures were performed during the study period out of which 46(7.6%) were bacterial culture positive. Twenty-seven(59%) were Early Onset sepsis and 19(41%) were Late onset sepsis. Male-female ratio was 1.7:1. Most common organism causing bacterial sepsis was Klebsiella Pneumoniae(28%), second was Acinetobacter baumani(22%), third was Staphylococcus aureus (20%), followed by Enterococcus (17%), E coli (9%) and finally CoNS(4%). Twenty-seven(59%) were gram positive organisms (67% caused EONS and 33% caused LONS)and 19(41%) were Gram Negative(58% caused EONS and 42% caused LONS). Levofloxacin had highest sensitivity to all the microorganisms. **CONCLUSION:** Neonatal sepsis can be treated with judicious use of antibiotics by studying the common microbial strains in the region and their antimicrobial susceptibility. Antibiotic stewardship should be stressed upon in every institution to protect patients from harm caused by unnecessary antibiotic use and combat the most dangerous threat of antibiotic resistance to the world.

KEYWORDS

Neonatal Sepsis, Microorganisms, Antimicrobial Susceptibility, Bacterial Resistance

INTRODUCTION

Neonatal Sepsis is infection in newborn babies within first 28 days of life and specially refers to presence of bacterial blood stream infection (such as pneumonia, meningitis, pyelonephritis or gastroenteritis)[1]. Neonatal sepsis is the leading cause of newborn mortality and morbidity worldwide. The three most common causes of newborn deaths globally are neonatal sepsis (36%), prematurity (28%) and birth asphyxia (23%)[2]. Early Onset neonatal sepsis is sepsis occurring within first 72 hours of life and Late Onset Neonatal Sepsis is sepsis occurring beyond first 72 hours of life[1]. Neonatal Sepsis is the most common cause of newborn death in hospital as well as in the community in developing countries[1]. Early Onset neonatal sepsis mostly occurs from the pathogens that contaminate the amniotic fluid, placenta, cervix and vagina of the mother and infects the baby either in the womb or during birth process and late onset sepsis is mostly acquired after the birth of the baby from the environment[3]. According to the National Neonatal Perinatal Database (2002-2003) the incidence of neonatal sepsis is 30/1000 live births[4]. Hence, to decrease the neonatal mortality and morbidity it is of utmost importance to know the common sepsis causing organisms and the antibiotics which will be effective in treating the sepsis. Various studies have been done in this regard but the spectrum of microorganisms causing neonatal sepsis shows variation in different regions of the world and also in different hospitals of the same region[5]. To combat this problem frequent studies from different regions of the world are required to detect the changing spectrum of microorganisms and also to know the most frequently prevalent organisms and their antibiotic susceptibility in a definite time period. So in this study we have tried to find out the common microorganisms causing neonatal sepsis and their antibiotic susceptibility in the present time frame.

AIMS AND OBJECTIVES

1. to look for common bacterial microorganisms causing neonatal sepsis in the admitted patients of the hospital
2. to look for the antibiotic sensitivity of the microorganisms causing neonatal sepsis in the admitted patients

MATERIALS AND METHOD

Place of Study: the study was conducted at Sanjivani Hospital, Jorhat, which is one of the busiest hospitals of Jorhat, Assam

Study Design: Hospital based observational study

Duration of Study: 18 months (May 2019 – October 2020)

Method of study: It was a cross-sectional study conducted in the admitted patients with suspicion of sepsis. 1-2 ml of blood was drawn prior to starting antimicrobial treatment maintaining strict aseptic and antiseptic precautions. Blood was collected and analysed in the laboratory as per standard hospital protocol. Quality assurance was strictly adhered to. Management of the neonates was done according to standard Neonatal Intensive Care Unit (NICU) protocol. Blood culture reports of all patients were traced from the hospital laboratory data. Positive culture reports for bacterial sepsis were separated and analysed. Institutional ethics committee clearance was obtained.

Exclusion criteria

1. Fungal sepsis cases were excluded
2. Babies with COVID-19 positive mothers
3. Contaminants were excluded from the study.

Variables studied included

1. Microorganisms causing neonatal sepsis and their distribution
2. Antimicrobial susceptibility of the microorganisms causing neonatal sepsis.

Statistical Methods: The data obtained was tabulated and analysed statistically using social science system version SPSS.16

RESULTS AND OBSERVATION

Total 602 blood cultures were sent during the study period out of which 46 were bacterial culture positive. The incidence of culture positive bacterial sepsis among sepsis-suspected babies was 7.6% out of which 29 (63%) were males and 17 (37%) were females. Among the culture positive sepsis babies 27 (59%) were Early Onset sepsis and 19 (41%) were Late onset sepsis.

Among the organisms causing bacterial sepsis 27 (59%) were gram positive organisms out of which 18 (67%) caused Early onset neonatal sepsis and 9 (33%) caused Late onset Sepsis. Among the sepsis causing organisms 19 (41%) were Gram Negative organisms out of which 11(58%) caused early onset neonatal sepsis and 10 (42%) caused late onset sepsis

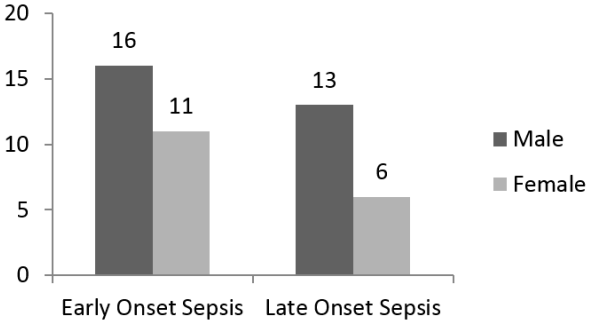

Fig 1: Figure showing Male and Female distribution in Early and Late onset Sepsis

Among the Early onset sepsis babies 16 (59%) were males, 11 (41%) were females and among those with Late onset sepsis 13 (64%) were males and 6(36%) were females.

Table I: Distribution of microorganisms in Early and Late onset sepsis

	EONS n=27	LONS n=19	TOTAL n=46
E Coli	3 (11%)	1 (5%)	4 (9%)
Enterococcus Species	4 (15%)	4 (21%)	8 (17%)
Staphylococcus	5 (18%)	4 (21%)	9 (20%)
Klebsiella Pneumoniae	8 (30%)	5 (26%)	13 (28%)
Acinetobacter Baumani	7(26%)	3 (16%)	10 (22%)
CONS	0	2 (11%)	2 (4%)

Analysis of the culture reports showed that the most common organism causing bacterial sepsis was Klebsiella Pneumoniae accounting for 28% of the cases. The second commonest organism was Acinetobacter baumani accounting for 22% of the cases, this was followed by Staphylococcus aureus (20%), then Enterococcus (17%), E coli (9%) and finally CoNS accounting for 4% of cases.

Of the organisms causing Early Onset Sepsis the most common was Klebsiella pneumoniae accounting for 30% of Early onset sepsis cases, second was Acinetobacter baumani accounting for 26% of cases, third was Staphylococcus (18%), followed by Enterococcus(15%) , then E coli(11%)

Among the organisms causing Late onset sepsis the most common was Klebsiella pneumoniae accounting for 26% cases, second was Staphylococcus aureus and Enterococcus species both accounting for 21% of cases, third was Acinetobacter baumani(16%), then CoNS(11%) and finally E Coli(5%)

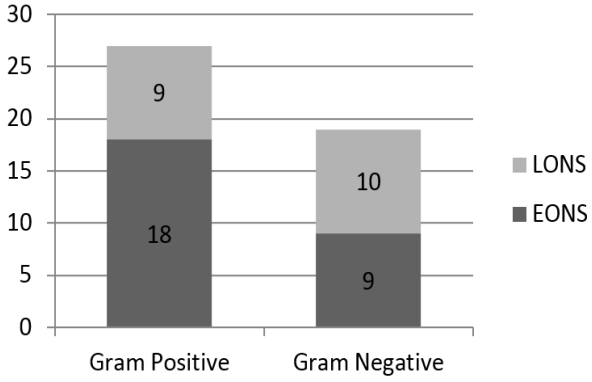

Fig 2: Figure showing distribution of Gram positive and Gram Negative organisms in Early and Late onset Neonatal sepsis

Among the organisms causing bacterial sepsis 27 (59%) were gram positive organisms out of which 18 (67%) caused early onset neonatal sepsis and 9 (33%) caused Late onset Sepsis. Among the sepsis causing organisms 19 (41%) were Gram negative organisms out of which 11(58%) caused early onset neonatal sepsis and 10 (42%) caused late onset sepsis.

Table II: Table showing Antibiotic susceptibility pattern of different microorganisms

SR NO.	Name of Drug	E Coli		Enterococci sp		Klebsiella Pneumoniae		Staphylococcus aureus		Acinetobacter Boumani		CONS	
		Sensitivity	MIC	Sensitivity	MIC	Sensitivity	MIC	Sensitivity	MIC	Sensitivity	MIC	Sensitivity	MIC
1	Amikacin	S	≤8	S	≤8	S	≤8	NT	NT	S	≤8	NT	NT
2	Amox/ K Clav	R	>16	R	>16/8	S	≤2	R	>4/2	I	>16/8	R	≤4/2
3	Ampicillin	R	>16	R	>16	R	>16	R	>8	R	>16	R	8
4	Aztreonam	S	≤1	S	≤4	ESBL	>16	NT	NT	R	>4	NT	NT
5	Cefepime	R	>16	S	≤1	R	>16	NT	NT	R	>16	NT	NT
6	Cefotaxime	R	>16	R	4	ESBL	>16	NT	NT	R	>16	NT	NT
7	Cefotaxime/ K Clavulanate	I	>4	I	4	I	≤0.5	NT	NT	R	>4	NT	NT
8	Cefoxitin	R	>16	I	16	S	≤8	S	≤4	I	>16	S	≤4
9	Ceftazidime	R	>16	I	8	ESBL	>16	NT	NT	R	>16	NT	NT
10	Ceftazidime/ K Clavulanate	I	>4	I	4	I	≤0.25	NT	NT	R	>4	NT	NT
11	Cefuroxime	R	>16	R	>16	R	>16	NT	NT	R	>16	NT	NT
12	Ciprofloxacin	I	2	S	≤0.12	S	≤1	S	≤1	S	≤1	S	≤1
13	Colistin	I	>4	I	>4	S	≤2	NT	NT	NT	NT	NT	NT
14	Ertapenem	R	>1	S	≤0.25	S	≤0.25	NT	NT	R	>1	NT	NT
15	Fosfomycin	R	>64	S	≤64	S	≤32	S	≤2	I	>64	S	≤32
16	Gentamicin	S	≤2	S	≤2	S	≤2	R	>8	S	≤2	S	≤4
17	Imipenem	S	≤2	R	>8	S	≤0.5	NT	NT			NT	NT
18	Levofloxacin	S	≤1	S	≤0.12	S	≤1	S	≤1	S	≤1	S	≤1
19	Meropenem	R	4	S	≤1	S	≤0.25	NT	NT	S	≤4	NT	NT
20	Minocycline	S	≤4	S	≤4	S	≤4	I	≤4	S	≤4	NT	NT
21	Nitrofurantoin	I	>64	I	>64	S	≤32	S	≤32	R	>64	2	≤32
22	Norfloxacin	S	≤1	S	≤0.5	S	≤1	NT	NT	R	>1	I	≤4
23	Ofloxacin	S	≤2	S	≤2	S	≤2	NT	NT	S	≤2	NT	NT
24	Pip /Tazo	R	>64	S	≤8	S	≤8	NT	NT	NT	NT	NT	NT
25	Piperacillin	R	>64	S	≤8	R	>64	NT	NT	R	>64	NT	NT
26	Tigecycline	S	≤1	I	2	S	≤1	NT	NT	NT	NT	NT	NT
27	Tobramycin	I	8	I	8	S	≤2	NT	NT	R	>8	NT	NT
28	Trimeth/ Sulfa	R	4/76	S	≤2/38	S	≤2	R	>2/38	R	>4/76	2	≤2/38
29	Cephalothin	NT	NT	NT	NT	NT	NT	R	>8	NT	NT	R	≤8
30	Chloramphenicol	NT	NT	NT	NT	NT	NT	S	≤8	NT	NT	S	≤8
31	Clarithromycin	NT	NT	NT	NT	NT	NT	R	>4	NT	NT	R	>4
32	Clindamycin	NT	NT	NT	NT	NT	NT	S	≤0.25	NT	NT	S	≤0.5
33	Daptomycin	NT	NT	NT	NT	NT	NT	S	≤1	NT	NT	S	≤1
34	Fusidic Acid	NT	NT	NT	NT	NT	NT	I	16	NT	NT	S	≤2

35	Linezolid	NT	NT	NT	NT	NT	NT	S	≤2	NT	NT	S	≤2
36	Moxifloxacin	NT	NT	NT	NT	NT	NT	S	≤0.5	NT	NT	S	≤0.5
37	Netilmicin	NT	NT	NT	NT	NT	NT	S	≤8	NT	NT	S	≤8
38	Penicillin	NT	NT	NT	NT	NT	NT	R	>8	NT	NT	R	>8
39	Rifampin	NT	NT	NT	NT	NT	NT	S	≤1	NT	NT	S	≤1
40	Teicoplanin	NT	NT	NT	NT	NT	NT	S	≤4	NT	NT	S	≤4
41	Vancomycin	NT	NT	NT	NT	NT	NT	S	≤2	NT	NT	S	≤2

*NT- Not tested
**MIC- Minimum inhibitory concentration
***S- Sensitive
****R- Resistance

Analysis of the blood culture reports showed that the most common organism causing bacterial sepsis, that is Klebsiella pneumoniae was sensitive to amikacin, amoxicillin with potassium clavulanate, cefoxitin, ciprofloxacin, colistin, ertapenem, fosfomycin, gentamicin, levofloxacin, meropenem, minocycline, nitrofurantoin, norfloxacin, ofloxacin, piperacillin tazobactum, tigecycline, tobramycin, trimethoprim sulfamethoxazole. MIC was lowest (≤1) for fluoroquinolones group (like ciprofloxacin, norfloxacin, levofloxacin) and for tigecycline. While it was resistant for ampiciilin, cefepime, cefuroxime and piperacillin. Intermediately sensitive for cefotaxime with potassium clavulanate, ceftazidime with potassium clavulanate.

Acinetobacter baumani was sensitive to amikacin, ciprofloxacin, gentamicin , levofloxacin, meropenem , minocycline, ofloxacin and resistant to ampicillin, aztreonam, cefepime, cefotaxime, cefotaxime with potassium clavulanate, ceftazidime, ceftazidime with potassium clavulanate, cefuroxime, ertapenem,, nitrofurantoin, norfloxacin, piperacillin, tobramycin, trimethoprim sulfamethoxazole. MIC was lowest (≤1) for Ciprofloxacin and levofloxacin.

Enterococcus species was sensitive to amikacin, aztreonam , cefepime, ciprofloxacin, ertapenem, fosfomycin, gentamicin, levofloxacin, meropenem, minocycline, norfloxacin ofloxacin, piperacillin tazobactum, piperacillin, trimethoprim sulfamethoxazol, and resistant to ampicillin, amoxicillin with potassium clavulanate, cefuroxime, imipenem. MIC was lowest (≤0.12) for Ciprofloxacin and levofloxacin.

E Coli was sensitive to amikacin, aztreonam, gentamicin, imipenem, levofloxacin, minocycline, norfloxacin, ofloxacin, tigecycline and resistant to amoxicillin with potassium clavulanate, ampicillin, cefepime, cefotaxime, cefoxitin, ceftazidime, , cefuroxime, ertapenem, fosfomycin, meropenem, piperacillin tazobactum, piperacillin, , trimethoprim sulfamethoxazole. Intermediate sensitivity for cefotaxime with potassium clavulanate, ceftazidime with potassium clavulanate, ciprofloxacin, colistin, nitrofurantoin, tobramycin. MIC was lowest (≤1) for norfloxacin, levofloxacin, tigecycline, aztreonam.

Staphylococcus aureus was sensitive to cefoxitin, ciprofloxacin, fosfomycin, levofloxacin, nitrofurantoin, clindamycin, daptomycin, linezolid, moxifloxacin, rifampin, teicoplanin, vancomycin and resistant to amoxicillin with potassium clavulanate, ampicillin, gentamicin, trimethoprim sulfamethoxazole, cephalothin, clarithromycin, penicillin. Intermediate sensitivity for fusidic acid, minocycline. MIC was lowest (≤0.5) for moxifloxacin which was followed by ciprofloxacin, levofloxacin, daptomycin and rifampin(≤1%).

Coagulase Negative Staphylococcus was sensitive to cefoxitin, ciprofloxacin, fosfomycin, gentamicin, levofloxacin, nitrofurantoin, trimethoprim sulfamethoxazole, chloramphenicol, clindamycin, daptomycin, fusidic acid, linezolid, moxifloxacin, netilmicin, rifampin, teicoplanin, vancomycin and resistant to amoxicillin with potassium clavulanate, ampicillin, cephalothin, clarithromycin, penicillin. Intermediately sensitive for norfloxacin. MIC was lowest (≤0.5) for moxifloxacin which was followed by ciprofloxacin, levofloxacin, daptomycin and rifampin(≤1%).

DISCUSSION

In this study we have tried to find out the common microorganisms causing neonatal sepsis and their antibiotic susceptibility in our geographical area at the present time. We have found that total 602 blood cultures were performed during the study period out of which 46 were bacterial culture positive. The incidence of culture positive bacterial sepsis among sepsis suspected babies was 7.6%. S Thapa et al in their study have found the incidence of significant bacterial growth to be 10.8%[6]

Among the bacterial sepsis positive babies 29 (63%) were males and 17 (37%) were females. Male Female ratio in our study was 1.8:1. Previous studies have also found that there is slightly higher incidence of sepsis among males. Male female ratio in their study was found to be 1.38:1[7]

Among the culture positive sepsis babies 27 (59%) were Early Onset sepsis and 19 (41%) were Late onset sepsis. Prevalence of Early onset sepsis was greater than Late onset sepsis. S Thapa et al in their study also found the prevalence of Early onset sepsis(62.5%) to be higher than Late onset sepsis(37.5%)[6]. Among the Early onset sepsis babies 16 (59%) were males, 11 (41%) were females and among those with Late onset sepsis 13 (64%) were males and 6(36%) were females. So the incidence of both the Early and Late Onset sepsis was higher in males as compared to females. M eman et al in their study have also found the incidence of neonatal sepsis to be higher in males. Male female ratio in their study was found to be 1.3:1[8].

Our study shows that the most common organism causing bacterial sepsis in neonates was Klebsiella pneumoniae accounting for 28% of the cases. The second commonest organism was Acinetobacter baumani accounting for 22% of the cases, this was followed by Staphylococcus aureus (20%), then Enterococcus (17%), E coli (9%) and finally CoNS accounting for 4% of cases. J Mohan et al in their study have found S aureus and Klebsiella spp to be the most common isolates[9] A review of studies in neonatal sepsis in India has found that the most common isolates were Klebsiella species in 15 studies, E coli in 10 studies and S aureus in 10 studies[10]. S Thapa et al has found Acinetobacter species to be the most common cause of neonatal sepsis in their study followed by Staphylococcus aureus[6]

Of the organisms causing Early Onset Sepsis the most common was Klebsiella pneumoniae accounting for 30% of Early onset sepsis cases, second was Acinetobacter baumani accounting for 26% of cases , third was Staphylococcus (18%), followed by Enterococcus(15%) and E coli(11%). S Thapa et al in their study has found the most common causative organism of early onset sepsis to be Acinetobacter followed by Staphylococcus aureus[6].

Among the organisms causing Late onset sepsis the most common was Klebsiella pneumoniae accounting for 26% cases, second was Staphylococcus aureus and Enterococcus species both accounting for 21% of cases, third was Acinetobacter baumani(16%), then CoNS(11%) and finally E Coli(5%). One previous study has found S. aureus to be the most common cause of late onset sepsis followed by Acinetobacter species and third was CoNS[6]. In our study we have found Klebsiella pneumoniae to be the most common cause of sepsis including early and late onset neonatal sepsis.

Klebsiella pneumoniae belongs to the family of Enterobacteriaceae. It is a gram negative bacteria Analysis of the blood culture reports showed that the most common organism causing bacterial sepsis, that is Klebsiella pneumoniae was sensitive to amikacin, amoxicillin with potassium clavulanate, cefoxitin, ciprofloxacin, colistin, ertapenem, fosfomycin, gentamicin, levofloxacin, meropenem, minocycline, nitrofurantoin, norfloxacin, ofloxacin, piperacillin tazobactum, tigecycline, tobramycin, trimethoprim sulfamethoxazole. MIC was lowest (≤1) for fluoroquinolones group (like ciprofloxacin, norfloxacin, levofloxacin) and for tigecycline, while it was resistant for ampiciilin, cefepime, cefuroxime and piperacillin.

Intermediate sensitivity for cefotaxime with potassium clavulanate, ceftazidime with potassium clavulanate was found. Ali Faisal et al in their study has found Klebsiella pneumoniae causing neonatal sepsis was mostly resistant to ampicillin, clavulanic acid, gentamicin, aztreonam and cephalosporins[11]. Klebsiella pneumoniae in our study

was mostly sensitive to fluoroquinolones and tigecycline. Ashis k Saha in their study has found Klebsiella pneumoniae was highly sensitive to polymyxin, colistin, imipenem, meropenem, ertapenem[12].

Acinetobacter baumani is a gram negative bacteria. It was found to be sensitive to amikacin, ciprofloxacin, gentamicin , levofloxacin, meropenem , minocycline, ofloxacin and resistant to ampicillin, aztreonam, cefepime, cefotaxime, cefotaxime with potassium clavulanate, ceftazidime, ceftazidime with potassium clavulanate, cefuroxime, ertapenem, nitrofurantoin, norfloxacin, piperacillin, tobramycin, trimethoprim sulfamethoxazole in our study. MIC was lowest (≤1) for Ciprofloxacin and levofloxacin. Asifa Nazir et al in their study has found Acinetobacter to be multidrug resistant to penicillin, cephalosporins, fluoroquinolones, aminoglycoside, carbapenem[13]. But in our study Acinetobacter detected was sensitive to fluoroquinolones, aminoglycosides and cephalosporins. It was not as dangerous as the multidrug resistant Acinetobacter causing neonatal sepsis in some other studies. Acinetobacter baumani in our institution was mostly sensitive to fluoroquinolones like levofloaxin and ciprofloxacin.

Enterococcus is a gram positive bacteria. Enterococcus species was sensitive to amikacin, aztreonam , cefepime, ciprofloxacin, ertapenem, fosfomycin, gentamicin , levofloxacin, meropenem, minocycline, norfloxacin ofloxacin, piperacillin tazobactum, piperacillin, trimethoprim sulfamethoxazole, and resistant to ampicillin, amoxicillin with potassium clavulanate, cefuroxime, imipenem in our study. MIC was lowest (≤0.12) for Ciprofloxacin and levofloxacin. Ruby M et al in their study have found Enterococcus to be highly sensitive to glycopeptides(vancomycin and teicoplanin) and nitrofurantoin[14]. But in our study it was mostly sensitive to ciprofloxacin and levofloxacin.

E Coli is a gram negative bacteria. It was sensitive to amikacin, aztreonam, gentamicin, imipenem, levofloxacin, minocycline, norfloxacin, ofloxacin, tigecycline and resistant to amoxicillin with potassium clavulanate, ampicillin, cefepime, cefotaxime, cefoxitin, ceftazidime, cefuroxime, ertapenem, fosfomycin, meropenem, piperacillin tazobactum, piperacillin, trimethoprim sulfamethoxazole in our study. Intermediately sensitive for cefotaxime with potassium clavulanate, ceftaxidime with potassium clavulanate, ciprofloxacin, colistin, nitrofurantoin, tobramycin. It was highly susceptible to norfloxacin, levofloxacin, tigecycline, aztreonam. M Kibret et al in their study has found E Coli to be sensitive to nitrofurantoin, norfloxacin, gentamicin and ciprofloxacin and resistant to erythromycin, amoxicillin and tetracycline[15]. Susceptibility pattern was similar to that in our study.

Staphylococcus aureus is a gram positive cocci. Staphylococcus aureus was sensitive to cefoxitin, ciprofloxacin, fosfomycin, levofloxacin, nitrofurantoin, clindamycin, daptomycin, linezolid, moxifloxacin, rifampin, teicoplanin, vancomycin and resistant to amoxicillin with potassium clavulanate, ampicillin, gentamicin, trimethoprim sulfamethoxazole, cephalothin, clarithromycin, penicillin. Intermediately sensitive for fusidic acid and minocycline. MIC was lowest (≤0.5) for moxifloxacin which was followed by ciprofloxacin, levofloxacin, daptomycin and rifampin(≤1%). Olufemi Emmanuel Akanbi et al in their study found Staphylococcus was mostly susceptible to Cefoxitin, chloramphenicol, levofloxacin, imipenem and resistant to erythromycin, clindamycin, rifampicin, penicillin G and ampicillin[16].

Coagulase Negative Staphylococcus is a type of staphylococcus that remains in the skin of people. They are usually harmless when they are outside the body but if they gain entry in blood stream they can cause infections[17]. CoNS was sensitive to cefoxitin, ciprofloxacin, fosfomycin, gentamicin, levofloxacin, nitrofurantoin, trimethoprim sulfamethoxazole, chloramphenicol, clindamycin, daptomycin, fusidic acid, linezolid, moxifloxacin, netilmicin, rifampin, teicoplanin, vancomycin and resistant to amoxicillin with potassium clavulanate, ampicillin, cephalothin, clarithromycin, penicillin. Intermediately sensitive for norfloxacin. MIC was lowest (≤0.5) for moxifloxacin which was followed by ciprofloxacin, levofloxacin, daptomycin and rifampin(≤1%). In a study done earlier it was found that antimicrobial resistance was shown by CoNS towards oxacillin, amoxicillin, amoxicillin plus clavulanate, ciprofloxacin, ofloxacin, ceftriaxone, erythromycin, clindamycin, daptomycin, kanamycin, fusidic acid , doxycycline, vancomycin and linezolid[18]. In their study CoNS showed significant level of resistance to most widely used therapeutic agents. But in our study CoNS was sensitive to most of the commonly used antibiotics.

We found that levofloxacin has the maximum sensitivity to all the microorganisms in our study. Studies have been done previously to see the spectrum of microorganisms causing neonatal sepsis and to know their antimicrobial susceptibility. But the spectrum of microorganisms shows wide variation in different regions of the world and also in different hospitals of the same region. They also keep changing in due course of time because of antibiotic overuse. The result is evident in various previous studies where the microorganisms have shown significant level of resistance to most of the commonly used antibiotics. So in this study we have tried to find out the common bacterial organisms causing neonatal sepsis in our region and their antibiotic susceptibility. We found that the most common organism was Klebsiella pneumoniae. Our study is one of the few studies where the microorganisms were not resistant to most of the commonly used first line antibiotics in the present era. This can be the result of judicious use of antibiotics.

Our study has one limitation. It being a retrospective study some of the data were missing but we compiled up all the information we could collect by trying our level best so that one or two data that were missed did not have any significant effect on the outcome of the study.

CONCLUSION

In this study we have tried to find out the common bacterial organisms causing neonatal sepsis in our region and their antibiotic susceptibility at present time scenerio. We found that the incidence of culture positive bacterial sepsis among sepsis suspected babies was 7.6%. Male female ratio was 1.7:1 . Early onset sepsis cases were more than Late onset Sepsis. The most common organism was Klebsiella pneumoniae in both early and late onset neonatal sepsis. Levofloxacin had highest sensitivity to all the microorganisms in our study. Microorganisms implicated in neonatal sepsis have become multidrug resistant and resistant to most of the commonly used antibiotics. But in our region the microorganisms were not resistant to most of the commonly used first line antibiotics. This can be the result of judicious use of antibiotics. Thus, we can infer that neonatal sepsis can be treated with common first line antibiotics provided we know the common microbial strains in our region and their antimicrobial susceptibility. There is no need to start with carbapenem or glycopeptides like strong antibiotics in every case thinking about drug resistance. So antibiotic stewardship should be stressed upon in every institution to protect patients from harm caused by unnecessary antibiotic use and combat the most dangerous threat of antibiotic resistance to the world.

REFERENCES

1. Neonatal sepsis [Internet]. En.wikipedia.org. 2020 [cited 17 November 2020]. Available from: https://en.wikipedia.org/wiki/Neonatal_sepsis
2. WHO | Newborn death and illness [Internet]. Who.int. 2020 [cited 17 November 2020]. Available from: https://www.who.int/pmnch/media/press_materials/fs/fs_newborn dealth_illness/en/
3. Singh M, Alsaleem M, Gray CP. Neonatal Sepsis. [Updated 2020 Sep 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-.REVIEW AND META‐ANALYSIS. Journal of Paediatrics and Child Health. 2019;55(S1):17-17.
4. Report of the National Neonatal Perinatal Database (National Neonatology Forum); 2002-03. Available from: http://www.newbornwhocc.org/pdf/nnpd_report_2002-03.PDF. [Last accessed on 2016 Feb 18].
5. Zea-Vera A., Ochoa T. J. Challenges in the diagnosis and management of neonatal sepsis. *Journal of Tropical Pediatrics*. 2015;61(1):1–13. doi: 10.1093/tropej/fmu079. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
6. Thapa S, Sapkota L. Changing Trend of Neonatal Septicemia and Antibiotic Susceptibility Pattern of Isolates in Nepal. International Journal of Pediatrics. 2019;2019:1-7.
7. Vasantha AR, Kutty SN, Joseph Theodore RB. Neonatal sepsis: Aetiological agents and risk factors. J AcadClinMicrobiol [serial online] 2017 [cited 2020 Nov 17];19:36-41. Available from: https://www.jacmjournal.org/text.asp?2017/19/1/36/208071
8. Eman M. RabieShehab El-Din, Mohamed M. Adel El-Sokkary, Mohamed RedaBassiouny, Ramadan Hassan, "Epidemiology of Neonatal Sepsis and Implicated Pathogens: A Study from Egypt", *BioMed Research International*, vol. 2015, Article ID 509484, 11 pages, 2015. https://doi.org/10.1155/2015/509484
9. Mohan J, Pavan Kumar D, Rakesh P, Prasad J, Joseph L. Bacteriological profile of neonatal sepsis in a secondary care hospital in rural Tamil Nadu, Southern India. Journal of Family Medicine and Primary Care. 2017;6(4):735.
10. Investigators of the Delhi Neonatal Infection Study (DeNIS) collaboration. Characterisation and antimicrobial resistance of sepsis pathogens in neonates born in tertiary care centres in Delhi, India: A cohort study. Lancet Glob Health 2016;4:e752-60. [PUBMED]
11. Saleem AF, Qamar FN, Shahzad H, Qadir M, Zaidi AK. Trends in antibiotic susceptibility and incidence of late-onset Klebsiellapneumoniae neonatal sepsis over a six-year period in a neonatal intensive care unit in Karachi, Pakistan. Int J Infect Dis. 2013 Nov;17(11):e961-5. doi: 10.1016/j.ijid.2013.04.007. Epub 2013 Jun 10. PMID: 23759260.
12. Saha, Ashis. (2019). Pattern of Antimicrobial Susceptibility of KlebsiellaPneumoniae Isolated from Urinary Samples in urinary Tract Infection in a Tertiary Care Hospital,

Kishanganj, Bihar, 5 Years' Experience. International Journal of Contemporary Medical Research [IJCMR]. 6. 10.21276/ijcmr.2019.6.12.42
13. Nazir A. Multidrug-resistant *Acinetobacter* septicemia in neonates: A study from a teaching hospital of Northern India. J Lab Physicians. 2019 Jan-Mar;11(1):23-28. doi: 10.4103/JLP.JLP_129_18. PMID: 30983798; PMCID: PMC6437821.
14. Rudy M, Nowakowska M, Wiechuła B, Zientara M, Radosz-Komoniewska H. Analizalekowrazliwości Enterococcus spp. izolowanych z moczu [Antibiotic susceptibility analysis of Enterococcus spp. isolated from urine]. PrzeglLek. 2004;61(5):473-6. Polish. PMID: 15515808
15. Kibret M, Abera B. Antimicrobial susceptibility patterns of E. coli from clinical sources in northeast Ethiopia. Afr Health Sci. 2011 Aug;11 Suppl 1(Suppl 1):S40-5. doi: 10.4314/ahs.v11i3.70069. PMID: 22135643; PMCID: PMC3220125.
16. Akanbi O, Njom H, Fri J, Otigbu A, Clarke A. Antimicrobial Susceptibility of Staphylococcus aureus Isolated from Recreational Waters and Beach Sand in Eastern Cape Province of South Africa. International Journal of Environmental Research and Public Health. 2017;14(9):1001.
17. Coagulase-Negative Staph Infection: Diagnosis, Symptoms, Treatment [Internet]. Healthline. 2020 [cited 19 November 2020]. Available from: https://www.healthline.com/health/coagulase-negative-staph
18. Ehsan M, Memon Z, Ismail M, Fatima G. Identification and antibiotic susceptibility pattern of coagulase-negative staphylococci in various clinical specimens. Pakistan Journal of Medical Sciences. 2013;29(6).