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Bacterial etiological agent, antibiotic susceptibility pattern and its associated factors among neonatal sepsis at Debre Markos Referral Hospital, Northwest Ethiopia

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Abstract

Aim: To assess bacterial etiologic agents, antibiotics susceptibility pattern and associated factors among neonatal sepsis at Debre Markos Referral Hospital Northwest Ethiopia.

Methods: Institutional based cross sectional study was carried out at Debre Markos referral hospital during December 2016 up to August 2017 from 120 septicemia suspected neonates. Blood sample was collected and standard microbiological analysis was performed. Data were entered by Epi Data version 3.1 and analyzed by SPSS version 22. Bivariate logistic regression model were fit to determine associated factors for neonatal sepsis. Odds ratio (95%CI)was calculated to determine the strength of associated factors for neonatal sepsis.

Results: The magnitude of bacteria was 37.5% and majority of them include *S. aureus*, *K. pneumoniae*, Coagulase negative Staphylococcus species, *E.coli*, Entrobacterspecies, Citrobacterspecies, *S.pyogenes*. Most of them were resistant to routinely prescribed antibiotics on the area such as amoxicillin (96%), ampicillin (91%),trimethoprim-sulfamethoxazole (83%), ceftriaxone (83%), gentamycin (74%) and doxycyclin (70%). Cesarean section mode of delivery, pre term gestational age and premature rapture of membrane were associated with bacterial infection.

Conclusion: The prevalence of pathogenic bacteria was too high. Most of them were resistant to common antibiotics prescribed on the area and factors such as Cesarean section mode of delivery, preterm gestational age and premature rapture of membrane were associated.

Key words: Antibiotics resistance, Bacteria etiology, Early onset, Late onset, Neonatal sepsis**,**

Background

Sepsis is a systemic inflammatory response disease caused by different bacteria, they release mediators to blood stream [1]. Neonatal sepsis is one of the most common reasons for neonatal morbidity, admission and mortality [2]. Neonatal sepsis could be classified in to early and late onset based on the time of symptoms and sign of sepsis occurrence. When the symptoms and sign of sepsis occur within the first 72 hours, it is known as Early-onset neonatal sepsis (EONS), and when it occurs after 72 hours, it is known as late-onset neonatal sepsis (LONS) [3]. The Majority of pathogens causing EONS includes *K. pneumoniae, E.coli, GBS,* CoNS,*H. influenzae* and *Listeria monocytogenes (L. monocytogenes),* whereas,*S. aureus,* CoNS, *K. pneumoniae, E. coli,* Enterobacterspecies, *Pseudomonas aeruginosa (P. aeruginosa)*andAcinetobacterspecies are the causative agents of LONS and these organisms are highly prevalent in developing countries [4, 5]. Even though, blood culture is gold standard diagnostic tool for sepsis; clinical characterization could be good predictors for sepsis diagnosis with its limitation of specificity and sensitivity, because negative blood culture does not rule out septicemia [6].

The identification of bacteria and their susceptibility patternis a cornerstone to provide direction to start empirical treatment in order to manage neonatal sepsis [7].Antibiotic resistant bacteria had been evolving due to the misuse of available antibiotics, this leads to change the sensitivity patternto common antibiotics. Therefore,studding bacteriological analysis and its antibiotic susceptibility pattern is essential [8]. Antibiotic resistant bacterial infection leads to an estimate of 6 to 9 per 1000 live birth neonatal infection worldwide. According to 2018, UNICEF data, Globally 2.5 million neonates are died within 28 day of birth [9, 10]. In developing countries the incidence of neonatal death caused by bacteria was 4-50% [11], of which 37 deaths per 1000 live birth was reported in Ethiopia [12].Different associated factors had been augmenting to worse neonatal infection after birth; some of these were prolonged labor, premature rapture of membrane, gestational age, cesarean delivery and very low birth weight [13].

Assessing the etiology of pathogenic bacteria and its antibiotic resistance pattern is necessary to prevent new infection and further complications of bacterial infection.To confirm the applicable intervention, existing information about bacteria that cause neonatal sepsis and their antibiotic resistance pattern is essential. Therefore, the aim of this study was to assess magnitude, antibiotics resistance pattern and associated factors of bacteria causing neonatal sepsis among neonates at Debre Markos referral Hospital Northwest Ethiopia.

Materials and methods

Study design, area, and period:

Institutional based cross sectional study was carried out at Debre Markos referral Hospital during December 2016 up to August 2017 from 120 septicemia suspected neonates.

Inclusion criteria: Neonates who developed symptoms and sign of sepsis during hospital stay and admission/readmission were included in this study.

Exclusion criteria: Neonates who started antibiotics at birth and/or during admission before sample collection were excluded in this study.

Study variables: The presence of bacteria from blood culture were dependent variable, whereas Socio-demographic and clinical variables such as age in days, sex, residence, prolonged labor, premature rapture of membrane, place of delivery, mode of delivery were independent variables.

Data collection and laboratory methods

Data collection

Socio-demographic and clinical variables such as age in days, sex, residence, prolonged labor, premature rapture of membrane, place of delivery, mode of delivery were collected by using structured questionnaire. The specimen was collected by interns (medical students) after getting informed written assent from the guardians of study participants.

Specimen collection and laboratory procedures

Before blood specimen was collected the area was cleaned by 70% denature alcohol and 2% Tincture iodine, and again by 70% denature alcohol to remove iodine. A total of 240 blood samples were collected from both arms each of 1-2ml for bacteriological laboratory analysis such as culture, Gram stain, biochemical and antibacterial susceptibility test. The collected blood samples were inoculated directly to two Trypton soya broth culture media and incubated at 37^0c aerobically. The broth culture showing a sign of bacterial growth such as hemolysis, gas bubble production and coagulation after overnight incubation was sub-culture to chocolate agar plate (CAP)with candle jar (5%- 10% CO_2), blood agar plate (BAP) and MacConkey agar (MAC) for 24 hours at 37^0c, but the broth culture which doesn't show a sign of growth was kept up to 7 daysand inoculated to CAP, BAP and MAC before discarding as negative. Discordant result was repeated and reported positive, if the finding was positive for two bottles and negative, if the finding was discordant for two bottles again.Positive culture plates were processed for further bacterial identification. Gram stain was done to differentiate Gram positive and Gram negative isolates.Biochemical tests such as: catalase, coagulase, Novobiocin disk, Bacitracin disk and Optochin disk test were used to identify specific Gram positive species whereas, triple sugar iron (TSI), indole, motility, urea, citrate, lysine decarboxylase (LDC) test were used to identify specific Gram negative species.

Antibacterial susceptibility tests

Antibacterial susceptibility tests were done by using modified Kirby-Bauer disk diffusion methods and interpreted according to clinical laboratory standard institute (CLSI) guideline [14]. Muller Hinton agar (MHA) culture media were used and antibiotics such as penicillin (10 IU),amoxicillin (10 µg),ampicillin (10 µg),Amoxacillin-Clavulanic acid (10µg /10 µg), trimethoprim-sulfamethoxazole (1.25/23.75 µg), ceftriaxone(30 µg), ciprofloxacin (5µg), nalidixic acid(30 µg),gentamycin (10 µg),chloramphenicol, and doxycycline (30 µg) were used to assess the resistance pattern of isolated bacteria. The criteria to select these antibiotics were accessibility of antibiotics on the area (hospital), frequent prescription, and CLSI guideline.

Antibacterial susceptibility test were done by taking 3-5 colony from pure culture and added to 5ml normal saline and mixed gently until homogeneous suspension was

formed and incubated 3-5 hours until the turbidity of the suspension was comparable with the density of 0.5% McFarland standard. Then the suspension was inoculated to MHA and BAP and allowed to dry for 5- 15 minute. Antibiotic disks were added to the media15 mm away from the edge of Petri dish and ≥24 mm apart from each other and incubated for 18-24 hours at 37^0c. After overnight incubation inhibition zone was measured by caliper and interpreted sensitive, intermediate and resistant according to the CLSI guide line [14].

Data management, analysis and interpretation

Each questionnaire was given a unique code and checked for data accuracy manually. Coded data was entered to Epi-Data version 3.1 for cross-checking and recoding, and then, exported to SPSS version 20 for analysis. Descriptive statistical analysis was presented in text, graphs, tables, frequencies, percentage, mean and standard deviation. Bivariate logistic regression analyses were performed to determine association between the outcome variable and the independent variables. Odds ratio (OR)was used as a measure of the strength of association and reported with 95% confidence intervals (95%CI). P value < 0.05 was considered to be statistically significant.

Data quality control

Steps in data collection and recording were monitored. The reagents were checked for expiry date and appropriate storage of temperature and humidity. Standard operative procedure (SOP) documents were prepared and strictly followed. The quality of culture media and antimicrobial susceptibility testing was checked by using quality control standard strains of *E. coli* ATCC 25922, *S. aureus* ATCC 25923and *K. pneumoniae* ATCC@BAA1705. McFarland standard (0.5%)was used to standardize the inoculums density of bacterial suspension for susceptibility test. The acceptance range of 0.5% McFarland optical density is 0.08–0.1 [14].

Ethical statement

Ethical clearance was obtained from Debre Markos Referral Hospital review board for the initiation of this study. There was no additional sample to be taken from the study participants but only for the sake of this study. Written informed consent was obtained from mothers after explaining the purpose and objective of the study. Participants would have full right to continue or withdraw at any time from this study. Laboratory resultswere communicated with physicians and nurses for timely and better patient management.

Results

A total of 120 neonates were participated in this study. Of which 53.3% were males and 46.7% were females. Fifty six46.7% were suspected for EONS and 53.3% were suspected for LONS. Among the total of neonatal sepsis suspected participants, 39.3%of EONS and 35.9% of LONS were confirmed for bacterial infection. Majority **61.7%**ofneonates had gestational age ranging from 37-42 weeks. Neonates who had gestational age less than 37 weeks were prone to infection 75.6%(34/45) compared with neonates who were ≥37 weeks and had infection rate 24.4% (11/45). Neonates born with VLBW had infection rate63.6% (7/11)**Table1.**

Type and frequency of bacteria

In this study, the overall magnitude of culture confirmed pathogenic bacteria was37.5% (n=45) and the predominant isolates were*S. aureus, K. pneumoniae,* CoNS, *E.coli*, Entrobacterspp, Citrobacterspp,*S.pyogenes*.The overall prevalence of Gram positive 22(49%) and Gram negative bacteria 23(51%)were almost

similar.The predominant isolates were *S. aureus* 16 (72.7%) and K. *pneumoniae*7(30.3%) among Gram positive and Gram negative isolates respectively(**Fig 1)**.

Antibiotics resistance pattern of bacteria

Antibacterial susceptibility test was performed to assess the resistance pattern of bacteria isolated from neonatal sepsis suspected participants. In the present study, Gram negative bacteria were highly resistant to commonly prescribed antibiotics than Gram positive bacteria. For instance AMX (96%), AMP (91%), SXT (83%), CRO (83%), GEN (74%) and DOC (70%) were resistance for Gram negative bacteria while AMX (73%), SXT (73%), DOC (64%), AMP (59%), and P (59 %) were resistance for Gram positive bacteria **Table 2.**

Neonatal sepsis associated risk factor analysis

Different associated factors were assessed by bivariate analysis, and some of them were associated with bacterial infection, like preterm delivery, premature rapture of membrane and cesarean section delivery, with crude odds ratio of 7.5(95%CI, 1.288, 43.687), 0.205(95%CI, 0.81, 0.521), and 6.44(95%CI, 1.123, 6.996), and p-value of (p=0.025), (p=0.001) and (p=0.037) respectively,**Table 3.**

Discussion

The pathogenic bacteria causing neonatal sepsis were varying from place to place in different hospitals and time to time even in the same hospitals. In the present study, the frequency of pathogenic bacteria isolated from neonatal sepsis suspected participants by blood culture was 37.5% and this finding was in agreement with different result report at Gondar (32.5%), and India (35.77%) [5, 15], but higher than study conducted in Nepal (21%) [2], and lowerthana study reported at Gondar (44.7%) [16].The predominant pathogenic bacteria was*S. aureus* (36%), *K. pneumoniae* (18%), *E. coli* (9%), Enterobacterspp (9%), and Citrobacterspp (9%) and this is in line with a study conducted at Gondar[17], *S. aureus* (40.8%), *K. pneumoniae* (15.8%), *E.coli* (10%) and Iran [18],*K. pneumoniae* (17.1%), Enterobacter spp (10.8%), and Citrobacterspp (6.3 %). This might be the fact that most of these bacteria are the causative agents of neonatal sepsis due to its high spread in the hospital settings and easily contaminated to neonates during hospital stay for delivery and admission [19]

Emerging and reemerging of antibiotics resistant bacteria is very sensitive issue now a days for the world health leaders and world people [20]. Majority of pathogenic bacteria was resistant to frequently prescribed antibiotics. For instance Gram negative bacteria was resistant to AMX (96%), AMP (91%), SXT (83%), CPR (83%) and DOC (70%), and Gram positive bacteria was resistant to AMX (73%), SXT (73%), DOC (64%), P (59%), and AMP (59%), this might be due to empirical prescription of broad spectrum antibiotics and misuse ofun prescribed antibiotics[21]. Among Gram negative bacterial isolates, *K. pneumoniae* was resistant to AMX (100%), AMP (87.5%),CPR (87.5%), SXT (87.5%), GEN (75%), and DOC (75%), and *E. coli* was resistant to AMX (75%), AMP (75%), CPR (75%), GEN (75%), and DOC (75%). On the other hand among Gram positive bacterial isolates, *S. aureus* was resistant to AMX (81%), P (69%), CRO (69%), AMP (63%), GEN (63%) and DOC (63%), this is in line with a study conducted at Maniple University and Pakistan respectively [22, 23]. This might be due to the mismanagement and misuse of antibiotics by health professionals and the patients respectively, poor sanitation of NICU bed

that contributing to the spread of antibiotic-resistant bacteria, and emerging of resistant bacterial strains due to indiscriminate use of antibiotics [24, 25]. In general the development of high resistance gene pool might increase antibiotic resistance bacteria which are the worst to neonates. So, this study showed clearly how antibiotics resistance bacteria are increase rapidly time to time.

In the present study, different associated factors were assessed to prove their contribution to bacterial infection, but some of them were confirmed their immediate role to augment bacterial infection to cause septicemia for neonates. Of these, preterm gestational week had 7.5 times more likely risk to neonatal sepsis (95% CI, 1.288, 43.687), (p=0.025), premature rapture of membrane had 0.205 times less likely risk to bacterial infection (95% CI, 0.81, 0.521), (p=0.001), and cesarean section mode of delivery had 6.44 times more likely risk to neonatal sepsis(95% CI, 1.123, 6.996), (p=0.037), this is in agreement with a study conducted at Indonesia [25]. This might be due to similarity of organism etiology, early recognition of associated factors aggravating to neonatal sepsis. Moreover, improving the cleanness of neonatology room, increasing newborn care and maternal care had been decreased the risk of bacterial infection, because the chance of pathogens surviving in the room and contamination to neonates are decreased [26].

Infection caused by antibiotic resistant bacteria increases health complications, such as long time patient hospital stay leading to bed sore, disability and death, economical and societal challenges to the community and family. So, assessing the etiology of pathogenic bacteria and its antibiotic resistance pattern is necessary to prevent new infection and further complications of bacterial infection. Even though, there were some limitations, this study was used to assess bacterial etiologic agents and their antibiotics resistance pattern among neonatal sepsis suspected participants.

The limitations of current study were the absence of an aerobic culture facility, the lack of minimum inhibitory concentration (MIC) for vancomycin to detect vancomycin resistant *S. aureus* (VRSA), lack of automated blood culture systems which has higher sensitivity of blood culture, and extended resistance panels and determination of likely mechanisms of antibiotic resistance bacteria like Methicillin-resistance, ESBL, carbapenemase were not performed. Therefore, researchers should consider these things for more sensitive, specific and accurate results which increase the health benefits of patients.

Conclusion and Recommendations

High prevalence of pathogenic bacteria had been identified and most of them were resistant to common antibiotics prescribed on the area. Different associated factors such as Cesarean section mode of delivery, pre-term age and premature rapture of membrane were associated to neonatal sepsis. Infection caused by antibiotic resistance bacteria increases health, economic and social complications. So assessing the etiology of pathogenic bacteria and its antibiotic resistance pattern is necessary to prevent new infection and further complications of bacterial infection. Therefore, Ministry of health and policy makers should be used updated and tangible information for budget allocation to early intervention.

Abbreviations

CONS=Coagulase Negative Staphylococcus Species, VLBW= Very Low Birth Weight, LBW=Low Birth Weight, NBW= Normal Birth Weight, OW= Overweight, HP= Health Post, HC= Health Center, C/S=

Cesarean Section, SVD= Spontaneous Vaginal Delivery, COR = Crude Odds Ratio

Declaration

Ethical statement

Ethical clearance was obtained from Debre Markos Referral Hospital review board for the initiation of this study. Written informed consent was obtained from mothers after explaining the purpose and objective of the study. Participants would have full right to continue or withdraw from this study. We were communicated about laboratory result with physician and nurse for timely and better patient management.

Consent for publication

Not applicable.

Availability of data and material

The original data for this study is available from the corresponding author.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors' contributions: AB and MGhad a concept of research idea, study design, data collection, laboratory analysis, interpretation, data analysis, and manuscript preparation.

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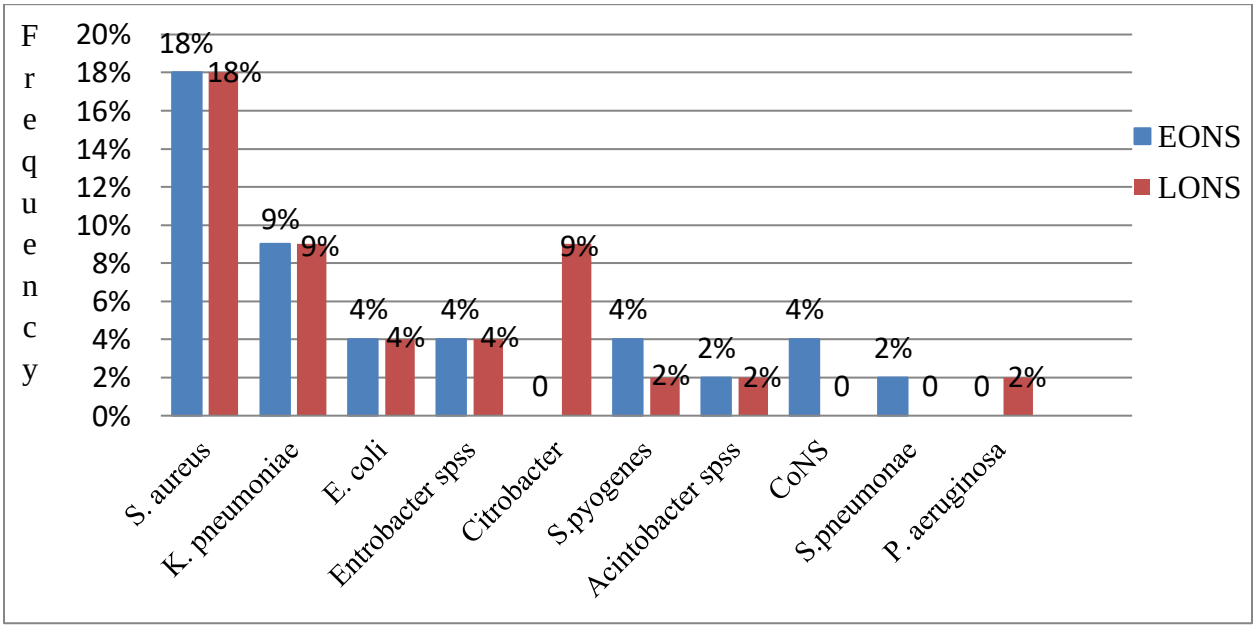

Figure 1. Frequency and types of bacteria causing neonatal sepsis at Debre Markos Referral Hospital.

Table 1.Socio-demographic, clinical and obstetric variables

Characteristics		Positive blood culture %	Negative blood culture %	Total (100%)
Age/sepsis	0-3(EONS)	22 (48.9)	34 (45.3)	56 (46.7)
	>3-28(LONS)	23 (51.1)	41(54.7)	64 (53.3)
Sex	Male	23 (51.1)	41(54.7)	64 (53.3)
Residence	rural	26 (57.8)	54 (72)	80(67.7)
Gestational age	Pre-term(<38 weeks)	34(75.6)	12(16)	46 (38.3)
	Term(38-42 weeks)	8(17.8)	60(80)	68(56.7)
	Post term (>42 weeks)	3(6.7)	3(4)	6(5)
Birth weight	VLBW(<1,500 g)	7(15.6)	4(5.3)	11(9.2)
	LBW(<2,500 g)	22(48.9)	28(37.3)	50(41.7)
	NBW (2,500-3,999 g)	16(35.6)	42(56)	20(16.7)
	OW (≥4000g)	0(0)	1(1.3)	1(0.8)
Intranasal oxygen	Yes	30(66.7)	38(50.7)	68(56.7)
Meconium stained amniotic fluid	Yes	5(11.1)	9(12)	14(11.7)
	No	40(88.9)	66(88)	106(88.3)
Types of health institute	HP	1(2.4)	7(9.6)	8(6.7)
	HC	18(43.9)	35(48)	53(44.2)
	Hospital	22(53.7)	31(42.4)	53(44.2)
Mode of delivery	C/S	33(73)	14(18.7)	47(39.2)
	SVD	9(20)	58(77.3)	67(55.8)
	Instrumental	3(6.7)	3(4)	6(5)
Prolonged labor	Yes	7(15.6)	10(13.3)	17(14.2)
Premature rapture of membrane	Yes	18(40)	9(12)	27(22.5)
Urinary tract infection	Yes	4(8.9)	4(5.3)	8(6.7)
Sexually transmitted infection	Yes	3(6.7)	6(8)	9(7.5)

Abbreviations: VLBW= very low birth weight, LBW=Low birth weight, NBW= Normal birth weight, OW= Overweight, HP= health post, HC= health center, C/S= cesarean section, SVD= spontaneous vaginal delivery

Table 2. Antibacterial susceptibility patterns of bacteria isolated from neonatal sepsis**.**

Bacterial isolates		**Antibiograms characteristics**										
		P	AMP	AMX	AMC	SXT	CRO	CPR	NAL	GEN	CAF	DOC
S. aureus (n=16)	**S%**	5(31)	2(12)	2(13)	13(81)	3(19)	5(31)	10(63)	10(63)	5(31)	13(81)	4(25)
	R%	11(69)	10(63)	13(81)	3(19)	13(81)	11(69)	6(37)	6(37)	10(63)	2(13)	10(63)
	I%	0(0)	4(25)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1(6)	1(6)	2(13)
S. pyogene (n=3)	**S%**	3(100)	2(67)	2(67)	3(100)	2(67)	3(100)	3(100)	3(100)	1(33)	3(100)	1(33)
	R%	0(0)	1(33)	1(33)	0(0)	1(33)	0(0)	0(0)	0(0)	2(67)	0(0)	2(67)
	I%	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
CoNS (n=2)	**S%**	0(0)	0(0)	1(50)	2(100)	0(0)	1(50)	1(50)	1(50)	0(0)	1(50)	0(0)
	R%	2(100)	1(50)	1(50)	0(0)	2(100)	1(50)	1(50)	1(50)	2(100)	1(50)	2(100)
	I%	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
S. pneumoniae (n=1)	**S%**	1(100)	0(0)	0(0)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)
	R%	0(0)	1(100)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	I%	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Total N=22	**S%**	9(41)	4(18.2)	5(23)	19(86)	6(27)	10(45)	15(68)	15(68)	12(55)	18(82)	6(27)
	R%	13(59)	13(59)	16(73)	3(14)	16(73)	12(55)	7(32)	7(32)	9(41)	3(14)	14(64)
	I%	0(0)	5(22.8)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1(4)	1(4)	2(9)
K. pneumoniae (n=8)	**S%**		1(12.5)	0(0)	5(63)	1(12.5)	1(12.5)	8(100)	7(87.5)	2(25)	3(37.5)	1(12.5)
	R%		7(87.5)	8(100)	3(37)	7(87.5)	7(87.5)	0(0)	1(12.5)	6(75)	5(62.5)	6(75)
	I%		0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(12.5)
E. coli (n=4)	**S%**		1(25)	1(25)	4(100)	1(25)	2(50)	3(75)	3(75)	1(25)	3(75)	1(25)
	R%		3(75)	3(75)	0(0)	3(75)	2(50)	1(25)	1(25)	3(75)	0(0)	3(75)
	I%		0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(25)	0(0)
Enterobacter spp (n=4)	**S%**		0(0)	1(25)	1(25)	1(25)	00	4(100)	3(75)	2(50)	3(75)	2(50)
	R%		4(100)	3(75)	3(75)	3(75)	4(100)	0(0)	1(25)	2(50)	1(25)	2(50)
	I%		0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Citrobacterspp (n=4)	**S%**		0(0)	0(0)	1(25)	0(0)	0(0)	2(50)	2(50)	0(0)	2(50)	1(25)
	R%		4(100)	4(100)	3(75)	4(100)	4(100)	2(50)	2(50)	4(100)	2(50)	3(75)
	I%		0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Acinetobacter (n=2)	**S%**		0(0)	0(0)	1(50)	1(50)	0(0)	2(100)	2(100)	1(50)	1(50)	1(50)
	R%		2(100)	2(100)	0(0)	1(50)	1(50)	0(0)	0(0)	1(50)	1(50)	1(50)
	I%		0(0)	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)
P. aeruginosa (n=1)	**S%**		0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)
	R%		1(100)	1(100)	0(0)	1(100)	1(100)	1(100)	1(100)	1(100)	0(0)	1(100)
	I%		0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Total N=23	**S%**		2(9)	1(4)	13(57)	4(17)	3(13)	19(83)	17(74)	6(26)	13(57)	6(26)
	R%		21(91)	22(96)	9(39)	19(83)	19(83)	4(17)	6(26)	17(74)	9(39)	16(70)
	I%		0(0)	0(0)	1(4)	0(0)	1(4)	0(0)	0(0)	0(0)	1(4)	1(4)

Abbreviations: P= penicillin, AMX=amoxicillin, AMP=ampicillin, CRO= ceftriaxone, CPR= ciprofloxacin, GEN= gentamycin, NAL= nalidixic acid, SXT=trimethoprim-sulfamethoxazole, DOC= doxycycline, CAF= chloramphenicol, AMC = Amoxacillin-Clavulanic acid

Table 3. Associated factors causing to neonatal sepsis

Variables		Blood Culture			P-value
		Positive (%)	Negative (%)	COR (95%)	
Gestational age	Preterm(<38 weeks)	34(75.6%)	12(16%)	7.5(1.288, 43.687)	0.025*
	Term(38-42 weeks)	8(17.8%)	60(80%)	0.35(0.063, 1.991)	0.238
	post term(>42 weeks)	3(6.7%)	3(4%)	1	
Premature rapture of membrane	Yes	18(40%)	9(12%)	0.205(0.81, 0.521)	0.001*
	No	27(60%)	66(88%)	1	
Mode of delivery	C/S	33(73%)	14(18.7%)	6.44(1.123, 6.996)	0.037*
	SVD	9(20%)	58(77.3%)	0.42(0.076, 2.367)	0.328
	I	3(6.7%)	3(4%)	1	

Abbreviations: COR = crude odds ratio, I= instrumental

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