

Risk Factor and Outcome Analysis for Neonatal Sepsis in Tertiary Care Neonatal Unit: A Cross Sectional Study

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Abstract

Background: The main issue in our nation is under-five mortality. The newborn period, which accounts for more than half of under-five child deaths, is the most vulnerable demographic in terms of under-five mortality. The goal of the current study was to look at the risk factor and outcome for neonatal sepsis in tertiary care neonatal unit.

Methods: The study was conducted on newborn infants who had the typical sepsis signs and symptoms after obtaining parental permission. The study took place from January 2022 until December 2022. After receiving sufficient parental consent, venous blood was taken from the newborns and tested for sepsis. A predesigned and typical questionnaire was utilised to gather information regarding the risk factors, and these newborns were treated in accordance with hospital protocol.

Results: Out of total 957 sepsis screen positive cases, 101(10.6%) were culture proven sepsis and 10(1.0%) died. Klebsiella (36.9%) was the most typical organism recovered from blood cultures. Maternal Fever and outcome have p value of 0.01. PROM and outcome have p value of 0.0005. Meconium-stained liquor and outcome have p value of 0.0005. Birth asphyxia and outcome have p value of 0.0005.

Conclusion: Birth asphyxia and neonatal sepsis mortality are significantly correlated with maternal fever, PROM, maturity, and birth asphyxia. Klebsiella was the most typical organism isolated from blood cultures. Maternal and family education, maternal nutrition, proper antenatal checkups, delivery at health facility, proper newborn care and proper hygiene are important steps to reduce the neonatal sepsis and thus under-five mortality. It is advised to conduct additional in-depth studies to better comprehend the risk factors and create management strategies.

Keywords: Neonatal sepsis, Gram negative bacteria, Diagnosis, Pregnancy.

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Introduction

The neonatal period (0-28 days of life) is the most vulnerable group in terms of under-five mortality, and it accounts for more than half of all under-five fatalities. The newborn period is the beginning of life, which lays the foundation for the nation's future health [1,2]. Neonatal sepsis occurs in 30/1000 live births, according to the NNPD for the years 2002–2003.[3] The Sustainable Development Goals offer a fresh approach to lowering newborn fatalities. By 2030, SDG 3 wants to lower newborn mortality to 12 deaths per 1000 live births. To meet SDG 3, the World Health Organization's Essential Newborn Care guidelines can be used which is evidence based measures. Breastfeeding, cord care, eye care, thermoregulation, asphyxia management, danger sign detection, immunisation, and care for low birth weight infants are all included. In order to properly care for the infant, it is necessary for both the mother and the carers to actively participate.

Sepsis is the second most frequent cause of death after premature delivery. The highest prevalence of clinical sepsis (17%) is found in India [5]. Neonatal sepsis can be brought on by a number of illnesses, including meningitis, osteomyelitis, septicemia, urinary tract infections, arthritis, and pneumonia. 25 to 40 percent of all newborn sepsis cases are culture-positive [6].

Combinations of risk factors and clinical indicators aid in therapy in underdeveloped nations like India due to resource limitations and the up to 48-hour delay in receiving a culture positivity report [6-9]. The goal of the current study was to examine newborn sepsis risk factors and outcomes in tertiary care neonatal unit. Neonatal mortality is a problem that needs to be solved on a global scale [10]. There is a critical need to create guidelines to save the lives of these newborns due to an increase in neonatal fatalities [11-13]. In light of this, WHO published

recommendations that should be followed [14]. Notwithstanding these recommendations, death rates are higher in industrialised and developing nations [15-19]. Therefore, it is imperative to assess the risk factors for neonatal sepsis.

So, I conducted this research to analyse the risk variables contributing to neonatal sepsis in order to help prevent risk factors, identify neonatal sepsis early, and manage it.

Material and Methods

The Neonatal Intensive Care Unit (NICU) in Department of Pediatrics at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, was the site of this cross-sectional study. The study took place from January 2022 until December 2022. Venous blood was collected for complete blood count, CRP, blood culture, and bedside Micro ESR in capillary blood after receiving informed written consent from the parents or carers of babies hospitalised with signs and symptoms of sepsis. The study included newborns who tested positive for sepsis (any 2 or more of the following 5 parameters: Total count <5000/cmm, Absolute neutrophil count low as per standard normograms for gestational age (<1800/cmm),

Immature to total neutrophil >0.2, Micro ESR >15mm in first hour, and CRP >10 mg/dl). In this study, 957 patients in total were examined. obtaining pertinent data and recording it in a proforma that has already been created. Neonatal patients were treated in accordance with our hospital's policy. All of the newborns who had signed up for the study were monitored until they passed away in the hospital. Analyses of sepsis risk variables and neonatal sepsis outcomes were conducted.

Data were processed with SPSS 23.0. The information was displayed using descriptive statistics.

Results

Table 1: Intra and extramural cases details of participants

		Total (957)	Recovery	Death	Culture proven sepsis	Death in culture Proven sepsis
Intra mural	Number	845	804	41	72	8
	Percentage	(88.3)	(95)	(5)	(9)	(11)
Extramural	Number	112	108	4	29	2
	Percentage	(11.7)	(96.4)	(3.6)	(25.5)	(8)

Among 957 cases, 845(88.3%) were intramural while 112(11.7%) were extramural. Out of 845 intramural cases, 428(50.7%) were male and 417(49.3%) were female. Out of 845 intramural cases, 804(95%) recovered and 41(5%) died. Out of 845 intramural cases, 72(9%) were culture proven. Out of 72 culture proven intramural cases, 8(11%) died. Out of 112 extramural cases, 108(96.4%) recovered and 4(3.6%) died. Out of 112 extramural cases, 29 (25.5%) were culture proven. Out of 29 culture proven extramural cases, 2(8%) died.

Table 2: Intramural Sepsis and Maternal Risk Factors

Maternal Risk Factors	Number(N=845)	Percent (%)
Maternal Age		
<20 Yrs	108	12.8
20 to 20 Years	632	74.8
>30 Yrs.	105	12.4
Gravida		
Primi	522	61.8
Gravida 2	205	24.2
Gravida 3	82	9.7
Gravida >3	36	4.3
Hemoglobin		
>10gm/dl	450	53.3
8to 10 gm/dl	313	37
<8gm/dl	82	9.7
PIH		
Yes	149	17.6
No	696	82.4
GDM		
Yes	128	15
No	717	85
Maternal Fever Within 2 Weeks Prior To Delivery		
Yes	98	11.6
No	747	88.4
Quantity of Liquor		
Normal	664	78.6
Oligohydraminos	132	15.6
Polyhydraminos	49	5.8
H/OUTI		
Yes	54	6.4
No	791	93.6

632(74.8%) of mothers of intramural cases were of 20-30 yr age group. 522(61.8%) of mothers of intramural cases were primi. 450(53.3%) of mothers of intramural cases were having hemoglobin >10gm/dl. 696(82.4%) of mothers of intramural cases have negative history of PIH. 717(85%) of mothers of intramural cases have negative history of GDM. 747(88.4%) of mothers of intramural cases have negative history of fever within 2 weeks prior to delivery. 664(78.6%) mothers of intramural cases were having normal liquor quantity. 791(93.6%) of mothers of intramural cases have negative history of UTI.

Table 3: Natal Risk Factors in Intramural Sepsis

Natal Risk Factors	Number(N=845)	Percent (%)
Place of Delivery		
Home/Transit	13	1.5
PHC/GH	20	2.4
Tertiarycare	812	96.1
Privatehospital	0	0
Mode of Onset of Labour		
Spontaneous	683	80.8
Induced	142	16.8
Membranes Ruptured Outside		
Yes	210	24.9
No	635	75.1
Prolonged Rupture of Membranes		
Yes	107	12.7
No	738	87.8
Mode of Delivery		
NVD	455	53.8
AVD	107	12.7
Electiveslcs	20	2.4
Emergencylscs	263	31.1
Liquor		
Normal	706	83.6
Bloodstained	7	15.6
Meconium Stained	132	0.8

812(96.1%) intramural cases born in out facility. 683(80.8%) Intramural cases have spontaneous onset of labour. 210(24.9%) intramural cases have outside ruptured membrane. 107(12.7%) intramural cases have prolonged rupture of membranes. 455(53.8%) intramural cases delivered by NVD. 706(83.6%) intramural cases have normal liquor appearance.

Table 4: Intramural Sepsis Risk Factors in Newborns

Neonatal Risk Factors	Number(N=845)	Percent (%)
Birth Weight		
<2.5kg	313	37
2.5to4kg	498	60
>4kg	34	3
Weight For Gestational Age		
SGA	116	14
AGA	689	81.5

LGA	40	4.5
Maturity		
Preterm	235	27.8
Term	574	67.9
Postdated	36	4.3
Birth Asphyxia		
No	724	86
Yes	121	14
Cord Care		
Good	823	97.4
Poor	22	2.6
Prelacteal Feeds		
Yes	22	2.6
No	823	97.4
Bad Crp		
Yes	31	3.7
No	814	96.3

498(60%) intramural cases have birth weight in range of 2.5 to 4.0 kg. 689(81.5%) intramural cases were AGA. 574(67.9%) intramural cases were term. 121(14%) intramural cases were birth asphyxiated. 823(97.4%) intramural cases have good cord care. Only 22(2.6%) intramural cases have given prelacteal feeds. Only 31(3.7%) intramural cases have bad CRP.

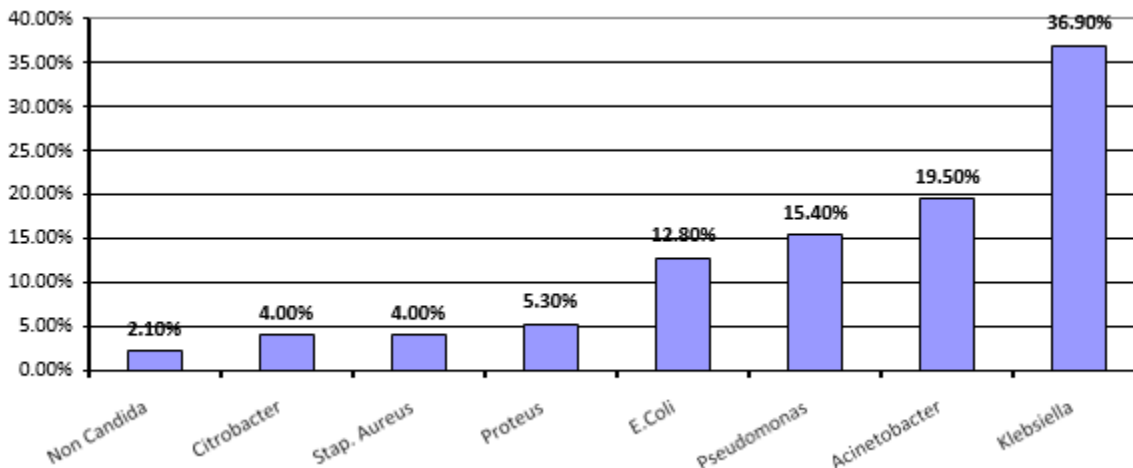


Figure 1: Organisms Grown in Culture in Intramural Sepsis

36.90% of culture proven intramural cases were due to *Klebsiella*. 19.50% cases were due to *Acinetobacter*. 2.1% cases were due to Non-candida Albicans.

Table 5: Maternal Risk Factors in Extramural Sepsis

Maternal risk factors	Total	
	Number(n=112)	Percent(%)
Maternal Age		
<20 Yrs	24	21.4
20 To20 Years	57	50.9
>30 Yrs.	31	27.7

Gravida		
Primi	26	23.2
Gravida 2	29	25.9
Gravida 3	45	40.2
Gravida >3	12	10.7
Hemoglobin		
>10gm/Dl	42	37.5
8to10gm/Dl	61	54.5
<8gm/Dl	9	8
Pih		
Yes	21	18.8
No	79	81.2
Gdm		
Yes	23	20.5
No	89	79.5
Maternal Fever Within 2 Weeks Prior To Delivery		
Yes	7	6.3
No	105	93.7
Quantity Of Liquor		
Normal	86	76.8
Oligohydraminos	17	15.2
Polyhydraminos	9	8
H/Outi		
Yes	8	7.1
No	104	92.9

57(50.9%) mothers of extramural cases were in 20-30 yr age group. 45(40.2%) of mothers of cases were gravida 3. 61(54.5%) mothers have hemoglobin in the range of 8-10 gm/dl. Only 21(18.8%) of mothers have history of PIH. Only 23(20.5%) of mothers have history of GDM. Only 7(6.3%) of mothers of extramural cases have history of fever within 2 weeks prior to delivery. 86(76.8%) of mothers of extramural cases have normal quantity of liquor. Only 8(7.1%) mothers of extramural cases have history of UTI.

Table 6: Natal Risk Factors in Extramural Sepsis

Natal risk factors	Total	
	Number(n=112)	Percent (%)
Place of Delivery		
Home/Transit	3	2.7
Phc/Gh	46	41
Tertiarycare	35	31.3
Private hospital	28	25
Mode of Onset of Labour		
Spontaneous	92	82.1
Induced	6	5.4
Membranes Ruptured Outside		
Yes	11	9.8
No	101	90.2
Prolonged Rupture Of Membranes		

Yes	12	10.7
No	100	89.3
Mode Of Delivery		
Nvd	64	57.1
Avd	5	4.5
Elective LSCS	15	13.4
Emergency LSCS	28	25
Liquor		
Normal	86	76.8
Bloodstained	1	0.9
Meconium stained	25	22.3

35(31.3%) extramural cases were delivered at tertiary care facility. 92(82.1%) of extramural cases have spontaneous onset of labour. Only 11(9.8%) extramural cases have outside ruptured membranes. Only 12(10.7%) extramural cases have prolonged rupture of membranes. 64(57.1%) of extramural cases have delivered by NVD.25(22.3%) of extramural cases have meconium-stained liquor.

Table 7: Neonatal Risk Factors in Extramural Sepsis

Neonatal risk factors	Total	
	Number(n=112)	Percent (%)
Birth Weight		
<2.5kg	42	37.5
2.5to4kg	64	58.9
>4kg	4	3.6
Weight For Gestational Age		
SGA	22	19.6
AGA	86	76.8
LGA	4	3.6
Maturity		
Preterm	25	22.3
Term	77	68.8
Postdated	10	8.9
Birth Asphyxia		
No	84	75
Yes	28	25
Cord Care		
Good	103	92
Poor	9	8
Prelacteal Feeds		
Yes	18	16.1
No	94	83.9
Bad CRP		
Yes	19	17
No	93	83
H/O NICU Admission		
Yes	24	21.4
No	88	78.6

64(58.9%) extramural cases have birth weight in range of 2.5 to 4.0 kg. 86(76.8%) extramural cases were AGA. 77(68.8%) extramural cases were term. Only 28(25%) extramural cases have history of birth asphyxia. Only 9(8%) extramural cases have history of poor cord care. Only 18(16.1%) extramural cases have history of prelacteal feeds. Only 19(17%) of extramural cases have bad CRP. Only 24(21.4%) of extramural cases have history of NICU admission.

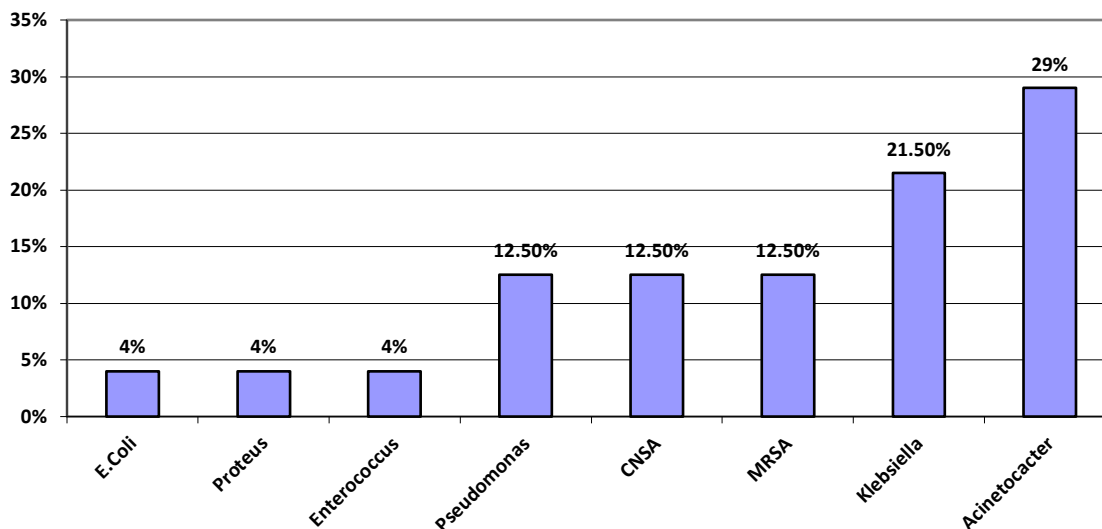


Figure 2: Organisms Grown in Culture in Extramural Sepsis

29% of culture proven extramural cases were due to *Acinetobacter*. 21.50% of culture proven extramural cases were due to *Klebsiella*.

Table 8: Relationship between Maternal Fever and Result (Intramural)

Maternal fever within 2weeks prior to Delivery	Outcome		Total
	Recovery	Death	
YES	Count	98	98
	%	12.2%	11.6%
NO	Count	706	747
	%	87.8%	88.4%
Total	Count	804	845
	%	100.0%	100.0%

	Value	df	Asymptotic Significance(2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.653b	1	0.017		
Continuity Correction	4.527	1	0.033		
Likelihood Ratio	10.379	1	0.001		
Fisher's Exact Test				.010	.006

Linear-by-Linear Association	5.646	1	0.017		
No. of Valid Cases	845				

Maternal fever had statistical significance with outcome with p value of 0.010.

Table 9: Association of PROM with Outcome(Intramural)

Prom		Outcome		Total
		Recovery	Death	
Yes	Count	93	14	107
	%	11.6%	34.1%	12.7%
NO	Count	711	27	738
	%	88.4%	65.9%	87.3%
Total	Count	804	41	845
	%	100.0%	100.0%	100.0%

	Value		Asymptotic Significance(2-sided)	Exact Sig. (2 sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.983b	1	0.0005		
Continuity Correction	16.000	1	0.000		
Likelihood Ratio	13.424	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	17.962	1	0.000		
No. of Valid Cases	845				

PROM had statistical significance with outcome with p value of 0.0005.

Table 10: Association of Liquor with Outcome (Intramural)

Liquor		Outcome		Total
		Recovery	Death	
Normal	Count	681	25	706
	%	84.7%	61.0%	83.6%
Blood Stained	Count	4	3	7
	%	.5%	7.3%	.8%
Meconium Stained	Count	119	13	132
	%	14.8%	31.7%	15.6%
Total	Count	804	41	845
	%	100.0%	100.0%	100.0%

	Value	df	Asymptotic Significance(2-sided)
Pearson Chi-Square	31.667b	2	0.0005
Likelihood Ratio	17.449	2	0.000
Linear-by-Linear Association	12.131	1	0.000
No. of Valid Cases	845		

Liquor had statistical significance with outcome with p value of 0.0005.

Table 11: Association of Maturity with Outcome (Intramural)

Maturity		Outcome		Total
		Recovery	Death	
Preterm	Count	212	23	235
	%	26.4%	56.1%	27.8%
Term	Count	560	14	574
	%	69.7%	34.1%	67.9%
Post Dated	Count	32	4	36
	%	4.0%	9.8%	4.3%
Total	Count	804	41	845
	%	100.0%	100.0%	100.0%

	Value	df	Asymptotic Significance(2-sided)
Pearson Chi-Square	22.692b	2	0.0005
Likelihood Ratio	20.759	2	0.000
Linear-by-Linear Association	8.429	1	0.004
No. of Valid Cases	845		

Maturity of the neonates had statistical significance with outcome with p value of 0.0005.

Table 12: Association of Birth Asphyxia with Outcome (Intramural)

Birth asphyxia		Outcome		Total
		Recovery	Death	
No	Count	701	23	724
	%	87.2%	56.1%	85.7%
Yes	Count	103	18	121
	%	12.8%	43.9%	14.3%
Total	Count	804	41	845
	%	100.0%	100.0%	100.0%

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	30.737b	1	0.0005		
Continuity Correction	28.255	1	0.000		
Likelihood Ratio	22.387	1	0.000		
Fisher's Exact Test				0.00	0.00
Linear-by-Linear Association	30.700	1	0.000		
No. of Valid Cases	845				

Birth Asphyxia had statistical significance with outcome with p value of 0.0005.

Discussion

51% of the newborns recruited were male, while 49% were female. Details of the participants' intra- and extra-mural cases are shown in Table 1. 522 (62%) of the infants' mothers were first time mothers. The risk factors for natal intramural sepsis are shown in Table 3. The most prevalent organism discovered from blood cultures was Klebsiella (36.9%). Other organisms that were isolated included Acinetobacter, Pseudomonas, E. coli, Staphylococcus aureus, Proteus, and Citrobacter. The culture found non-Candida albicans in 2.1% of cases.

29 incidences (or 25%) of culture-proven sepsis were found among the 112 extramural newborns. Infant mortality from sepsis was 3.5%. (4 cases). Two of the infants had sepsis with culture proof.

Place of delivery, method of delivery, cord hygiene, and poor child rearing practises all demonstrated statistically significant associations with extramural sepsis. The gestational age and place of delivery were identified in the Sunit Pathak *et al.*[12] investigation as risk factors for sepsis. The link between sepsis and prematurity in my study is not statistically significant because the peripheral centres refer the mother with a predicted preterm delivery to the tertiary care centre early and the admission of prematurity is low in extramural settings.

Prematurity (p value 0.0002) and PROM (p value 0.0001) had a substantial connection with neonatal sepsis in Shruthi Murthy *et al* [9] meta-analysis of risk variables for neonatal sepsis, which is similar to my work. The study by Shruthi Murthy *et al.* [9] demonstrated that outborn admissions had a greater rate of culture-positive sepsis than inborn neonates. In my study, only 9% of intramural neonates experienced sepsis that was culture-positive, compared to 25% of

extramural neonates. 72 (8%) of the 845 intramural neonates had sepsis with a positive culture. Neonatal sepsis-related mortality was 5% among 845 infants. (41 babies). Sepsis was culture-proven in 19% (8 cases) of the fatalities.

Klebsiella, which was similar to Anitha Sethi *et al.*[14], was the organism that was isolated from blood cultures the most.

Premature membrane rupture, meconium-stained amniotic fluid, prematurity, and birth asphyxia all had statistically significant associations with neonatal sepsis mortality, which is similar to studies by Leal *et al* [19], Medhat *et al* [20], Kayangen *et al* [21], Siakwa *et al* [22], Gebremedin *et al* [23], and Simonsen *et al* [24] in various parts of the world.

In Dubey A and Kale PV study [25], 67.7% were preterm and 32.3% were term while in our study 27.8% were preterm and 67.9% were term(intramural). Only 21.5% were normal birth weight, while in our study 60.0% were normal birth weight(intramural). 43% were NVD, 55.4% were LSCS and 1.5% were AVD while in our study 53.8% were NVD, 33.5% were LSCS and 12.7% were AVD (intramural).10.8% have history of maternal fever while in our study 11.6% have history of maternal fever(intramural). 50.8% were primigravida while in our study 61.8% were primigravida (intramural).

Conclusion

Sepsis was statistically significantly correlated with the place and style of delivery, cord hygiene, poor child-rearing practices, and place of delivery. Premature membrane rupture, meconium-stained amniotic fluid, preterm, and birth asphyxia all demonstrated statistically significant correlations with the mortality of newborn

sepsis. Maternal fever within two weeks of delivery. Blood culture positive was statistically significantly correlated with PROM and prematurity. In my investigation, Klebsiella was the most typical bacteria identified from the blood culture. It is advised to do additional in-depth investigations to better comprehend the risk variables and create management strategies.

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