Maternal and Neonatal Risk Factors for Developing Early Onset Newborn Sepsis (EONS) in a Tertiary Care Hospital

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Abstract:

Background: Despite recent improvements in intensive care units, sepsis remains one of the leading causes of morbidity and mortality in neonates worldwide. Finding maternal and neonatal risk factors for early onset newborn sepsis (EONS) at a tertiary care hospital is the aim of this study.

Methods: This cross-sectional study was conducted from August 2023 to January 2024 among newborns who had clinical symptoms of sepsis found within 72 hours of postnatal age in the Department of Obstetrics and Gynecology at SKMCH, Muzaffarpur, Bihar, in collaboration with the Pediatrics department. The clinical profile and risk factors (both maternal and neonatal) were recorded in a pre-made data collecting sheet following the acquisition of the parents' informed written consent. To confirm the diagnosis, C/S and blood were drawn for septic screening.

Results: 90 percent of the neonates had maternal risk factors for sepsis, while only ten percent did not have any. PROM > 18 hours was present in the mothers of most (80.0%) babies with sepsis. Within two weeks of birth, one-third of the women experienced fever, lower abdomen pain, or UTIs. The moms of the infant septic cases exhibited protracted labor in over half (56.7%) of the cases. The majority of babies (58.2%) had gestational ages of less than 37 full weeks. Sixty-seven percent (66.7%) of babies had birth weights under 2,500 grams. Thirty-one percent of the babies received prelacteal feedings. Seventy-one percent (70.0%) of babies received 2% chlorohexidin. At birth, six (10.0%) babies needed bag mask resuscitation.

Conclusion: Maternal risk factors for neonatal sepsis were protracted labor, P/V examination more than three times, and PROM > 18 hours. Prematurity, low birth weight and prelacteal feeding are among the risk factors for newborns.

Keywords: Maternal and neonatal risk factors, early onset newborn sepsis.

Introduction

In developing countries, where the prevalence of newborn septicemia is 1.6% of all live births, neonatal sepsis is a major public health concern that continues to be a substantial contributor to neonatal morbidity and mortality [1]. The most prevalent issue in the newborn period that led to a high rate of morbidity and mortality was early and late neonatal septicemia.

WHO estimates that it accounts for 30–50% of newborn fatalities in underdeveloped nations [2]. A clinical laboratory illness known as early newborn septicemia is brought on by infections, their toxins, or their antigens entering the bloodstream in the first 72 hours of life [3]. The clinical diagnosis is established based on non-specific symptoms, such as the newborn's low or high body temperature,

lethargy, irritability, tachypnoea or episodes of apnea, rapid or weak pulse, hypotension, low or high blood sugar, and metabolic acidosis [4].

Maternal factors (prenatal fever, intrauterine infection, low birth weight, perinatal asphyxia, low Apgar scores, multiple pregnancies, frequent vaginal exams, premature rupture of membranes more than 18 hours), neonatal factors (prematurity, low birth weight, intrauterine infection, low Apgar scores), and environmental factors (use of resuscitation tools, medical and nursing staff) are among the many risk factors for early neonatal sepsis. [5] The laboratory criteria for early newborn sepsis include white blood cells (WBC), neutrophil count, C-reactive protein (CRP), and platelet count

(PLT). The gold standard for diagnosis is blood culture [6].

In 2022, neonatal mortality rate for India was 18.1 deaths per 1,000 live births. Neonatal mortality rate of India fell gradually from 82.6 deaths per 1,000 live births in 1973 to 18.1 deaths per 1,000 live births in 2022.

The highest rate of clinical sepsis (17,000/1,000,000 live births) is found in India. [7]. In India, the case fatality rate from sepsis in newborns varies from 25% to 65%. [8,9] These rates are probably underestimates, and the "Global Maternal and Neonatal Sepsis Initiative" should provide more precise data. [10–12]

Sepsis in newborns can happen in any type of circumstance, including asphyxiated, premature, and typical newborns. Therefore, it is a fairly prevalent infant health problem that quickly poses a threat to life. Newborn sepsis is largely caused by a number of risk factors, including both maternal and neonatal ones. Of particular importance is early onset newborn sepsis (EONS). By identifying these risk variables, preventive antibiotic medication and newborn septic screening can be implemented, potentially leading to a considerable decrease in neonatal morbidity and mortality. Consequently, the purpose of this study was to monitor and identify risk factors (for both mothers and newborns) from the viewpoint of our community.

Material and Methods

This cross-sectional study included 60 newborns who were hospitalized to the NICU of Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, from August 2023 to January 2024 with clinical signs of newborn sepsis within 72 hours of their birth. Age, sex, gestational age, birth weight, age at admission, type of delivery, type of pregnancy, use of assistive devices, premature rupture of membranes, maternal age, mother's genital and urinary tract infections, mother's laboratory evaluation, amniotic fluid, need for resuscitation, and a thorough clinical examination of the patients were all documented in detail on the research form upon admission. In the SKMCH laboratory, CBC, CRP, and a blood culture were performed to diagnose septicemia.

Informed consent was obtained from the patient's parents.

The Statistical Package for Social Sciences (SPSS version 20) was used to examine all of the data. For every quantitative variable, descriptive statistical characteristics were computed, including the mean, standard deviation, frequencies, and percentage.

Results

Of the sixty newborns that showed signs of sepsis, 29 (57.3%) were female and more than half (51.7%) were male. 48(80.0%) were inborn, while twelve 12(20.0%) were outborn (Table 1).

Table 1: Distribution of the study subjects by sex and place of delivery (n=60)

Sex of newborn	No. of cases	Percentage
Male	31	51.7%
Female	29	49.3%
Place of birth		
Inborn	48	80%
Out-born	12	20%

54(90.0%) of the newborns had maternal risk factors for sepsis, while only six(10.0%) had none (Table 2).

Table 2: Mother's risk factors of sepsis status of study subjects (n=60)

Mother's risk factors of sepsis status	No. of cases	Percentage
Yes	54	90%
No	6	10%

The majority of mothers (80.0%) of newborns with sepsis had PROM>18 hours, and one-third had fever, lower abdomen pain, or urinary tract infection (UTI) in the two weeks following birth.

Mothers who gave birth to septic newborns in more than half (56.66%) of the cases had laboured for longer than 24 hours (for primipara and more than 18 hours for multipara). During their pregnancies, four moms (6.66%) had foul-smelling P/V discharge. 20(33.33%) of mothers with infant sepsis had alcohol stained with meconium at the time of delivery.

Nearly half (43.33%) of the newborns with early-onset sepsis had a mother who had previously undergone P/V examination more than three times (Table -3).

Table 3: The distribution of study subjects mother's risk factors of sepsis (n=60)

Mother's risk factors of sepsis	No. of cases	Percentage
PROM >18 hours	48	80.0%
UTI/Lower abdomen pain/Fever	20	33.33%
Prolonged labour	34	56.66%

Foul smelling P/V discharge	4	6.66%
Mcconium stained liquar	20	33.33%
No of P/V examination >3 times	26	43.33%
LUCS delivery	42	70.0%
NVD delivery	18	30.0%
NVD home	10	16.66%
NVD hospital	14	23.33%

The majority of newborns 35(58.3%) had gestational ages of fewer than 37 full weeks. 40 (66.7%) of newborns had birth weights under 2,500 grams. 18(30%) of the newborns received prelacteal feedings. 42 (70.0%) of newborns received 2% chlorohexidin. At birth, 6 (10%) newborns needed to be revived using a bag mask (Table 4).

Table 4: Distribution of the study subjects by neonatal risk factors of sepsis (n=60)

Neonatal risk factors of sepsis	No. of cases	Percentage
Gestational age (weeks)		
• ≤28	0	0
• 28 to <34	3	5%
• 34 to <37	35	58.3%
• 37-42	17	28.2%
• ≥42	5	8.3%
Birth weight (gm)		
• 1000-1499	2	3.3%
• 1500-2499	40	66.7%
• >2500	18	30%
H/O pre-lacteal feeding		
• Yes	18	30%
• No	42	70%
2% Chlorhexidine given		
• Yes	42	70%
• No	18	30%
Resuscitation (Bag mask) required at birth		
• Yes	6	10%
• No	54	90%

It was noted that of the participants, 26(43.3%) were unwilling to feed, and the other 25% experienced respiratory distress, 23.3% hypothermia, 20.0% were lethargic, 6.7% had convulsions, 3.3% had dyspnea, 3.3% had diarrhea, 3.3% had fever, 3.3% had vomiting, 3.3% had bleeding symptoms, and 1.7% experienced shock (Table 5).

Table 5: Distribution of the study subjects by symptoms (n=60)

Symptoms	No. of cases	Percentage
Reluctant to feed	26	43.3%
Respiratory distress	15	25%
Hypothermia	14	23.3%
Lethargic	12	20%
Convulsions	4	6.7%
Diarrhea	2	3.3%
Fever	2	3.3%
Vomiting	2	3.3%
Bleeding manifestations	2	3.3%
Shock	1	1.7%

According to the physical indicators, the bulk of the cases (80.0%) were pink in color, followed by icteric (13.3%) and cyanosis (6.7%). The majority of individuals (43.3%) had signs of respiratory distress. 3.3% and 16.7%, respectively, were hypothermic and hyperthermic. Thirty percent of the participants had a Capillary Refill Time (CRT) greater than three seconds. A quarter (24.3%) of the individuals had an enlarged abdomen. 13.3% of the patients had pus coming out of their umbilicus.

Among the patients, two thirds (66.7%) exhibited reduced rudimentary reflexes. Of the subjects, 50% had oliguria. Two thirds (66.7%) of the individuals had a normal WBC total count. The majority of individuals (90.0%) exhibited a normal ratio of immature to total neutrophils (I/T). A quarter (23.3%) of the individuals had ANC (less than 1500/mm³). The platelet count of over three-quarters (76.7%) of the patients was normal. One-half (40.0%) of the individuals tested positive for

CRP. Blood cultures were positive in eight (13.3%) of the individuals (Table 6).

Table 6: Distribution of the study subjects by laboratory findings (n=60)

Laboratory Findings	No. of cases	Percentage
Total count of WBC		
• Normal	40	66.7%
• Leukopenia (< 5000/mm3)	8	13.3%
• Leukocytosis (> 25000/mm3	12	20%
I/T ratio		
• Normal	54	90%
• Altered	6	10%
ANC: <1500/mm3		
• Yes	14	23.3%
• No	46	76.7%
Platelet count		
• Normal	46	76.7%
• Thrombocytosis	8	13.3%
• Thrombocytopenia	6	10%
CRP		
• Positive	24	40%
• Negative	36	60%
Blood culture		
• Positive	8	13.3%
• Negative	52	86.7%
Sensitivity of empirical antibiotics to isolated organism		
• Sensitive	4	6.7%
• Not sensitive	2	3.3%

Table-7 had found Staphylococcus aureus, Enterobacter 2(33.33%), 1(16.66%) Klebsiella species and 1(16.66%) had E.coli.

Table 7: Shows the organisms of culture positive subjects (n=6)

Organisms of culture	No. of cases	Percentage
Staphylococcus aureus	2	33.33%
Enterobacter	2	33.33%
Klebsiella sp.	1	16.66%
E.coli	1	16.66%

Discussion

51.7% of the subjects in this study were male and 49.3% were female, which is comparable to the findings of the Nyma et al. study, which indicated that 58.0% and 42.0% of the subjects were male and female, respectively [13]. Another study [14] found that 40.2% of the neonates were female and 59.8% were male. Sohail et al., on the other hand, observed that females predominated, with 55.0% of the neonates being female and 45.0% being male [15].

Nonetheless, other research noted observations on the male predominance, including Noah et al. [16,17,18,19]. According to some theories, male newborns were more likely than female newborns to have septicemia (sepsis), which may have been caused by immune system genes particular to a person's gender [20,21, 22]. 80.0% of the participants in this study were found to be inborn, and 20.0% to be outborn. According to Nyma et al., 16.0% of the moms who took part in the study had previously given birth at home, and 1.16% had previously given birth on the sidewalk while en route to the hospital [13]. According to a survey, 2.6% of babies were born at home and 97.4% were born in medical facilities [23]. Compared to neonates from comparable in-hospital births, newborns born in an unexpected setting have higher rates of respiratory distress, hypoglycemia, and hypothermia, which increases the likelihood that they may need to be admitted to special care nurseries or intensive care units (ICUs). Out-of-hospital births are linked to a higher incidence of maternal problems, such as severe birth canal lacerations, uterine rupture, and postpartum hemorrhage, than in-hospital births. The rate of neonatal infection in out-of-hospital births was eleven times greater than in in-hospital births. Neonates may be more susceptible to infection if their birthplaces are contaminated, their cords are not cut properly, or they receive inadequate perinatal care [24].

The study's findings regarding neonatal sepsis symptoms are in line with those of Mahallei et al., who found that prevalent clinical symptoms of the

condition included fever, poor feeding, neonatal icterus, tachypnea, and respiratory distress.

13.3% of the participants in this study exhibited leucopenia, 20.0% had leucocytosis, and 10.0% had an abnormal I/T ratio. Mahallei and Utomo's investigation revealed that 6.2% of newborns had leucopenia, with a mean leukocyte count of 11,407 cells/mm^3. Leucocytosis was found in 41.2% of cases, leucopenia in 15.7%, and changed I/T ratio in 54.9% of cases, according to another study20. The results of the CRP tests that were performed on all newborns in the Mahallei et al. [14] study were 43.1% positive and 56.9% negative, which is similar to the results of the current investigation (40% vs. 60%, respectively).

The most reliable method for making a conclusive diagnosis of newborn sepsis is still blood culture. According to this study, 6.7% of participants demonstrated antibiotic sensitivity to an isolated bacterium, and eight (13.3%) had blood cultures that were positive. Neonatal blood cultures revealed positive results in 65.7% of the neonates in the research, and some of them showed positive results more than once [14]. The culture positive rate in two previous studies 37.63% and 31.75%, respectively was likewise higher than it is in this one [25,26]. As a result, cultural positivity rates differ greatly between locations. 13–22.0% [27] was the culture positivity rate in an Indian study, which is consistent with the current investigation.

In this investigation, prevalent blood culture pathogens included 17.0% E. coli, 33.0% Enterobacter, 17.0% Klebsiella species, and 33.0% Staphylococcus aureus. In research by Haq et al. [28], Anwar [29], and others, Klebsiella species were found to be 25.0%, Escherichia coli to be 15.0%, and Staphylococcus aureus to be 18.0%.

Pregnancy- and delivery-related health problems may raise the chance of early-onset neonatal sepsis. Both anaerobic and aerobic bacterial species populate the human birth canal, and infections with ascending amniotic fluid can spread vertically. Furthermore, during their transit through the birth canal, babies may be exposed to potentially harmful bacteria, viruses, or fungi, which can result in infection. Early onset infant sepsis is known to be associated with maternal infections such as UTIs, leukocytosis within 15 days after delivery, fever, and premature rupture of membrane (PROM) lasting longer than 18 hours. 90.0% of the study's participants had maternal risk factors for sepsis, of which PROM>18 hours was more common (80.0%), and 33.3% had experienced fever, lower abdomen pain, or a UTI in the previous two weeks. Kolhe et al. discovered in another study that 2.0% of mothers had chorioamnionitis20, 33.0% had PROM, 25.5% had leucocytosis, 7.8% had intrapartum fever, and 5.9% had UTI. The results

of the new study are comparable to those of the previously stated investigations. A study found that most newborns have early-onset sepsis, which can happen in utero as a result of either transplacental or ascending bacteria that enter the uterus from the vaginal environment after the membranes rupture [30].

Early onset neonatal sepsis may be caused by additional maternal variables such as the mode of delivery, length of labor, color of amniotic fluid, number of p/v examinations, etc. In this study, 56.7% of labors were extended, and 70.0% of babies were delivered using LUCS. According to Jajoo et al., there are a number of maternal risk factors for early neonatal sepsis, including genital and urinary infections, fever during pregnancy, prenatal laboratory septicemia, multiple pregnancies, frequent vaginal exams, premature rupture of the membranes for longer than eighteen hours, and environmental factors like using resuscitation equipment and having medical and nursing staff support the current study [31].

The current study found that two thirds (66.7%) of the newborns were low birth weight, and over half (58.2%) belonged to the gestational age group of less than 37 full weeks, which is associated with a higher risk of sepsis in neonates. Newborns that are premature or low birth weight are more vulnerable to neonatal sepsis due to weakened immune systems.

According to Gebremedhin et al.'s study, preterm and low birth weight (LBW) affect most neonates and are associated with health risks for both developed and developing nations' newborns. [32] Neonatal sepsis can be significantly impacted by newborns with LBW, according to a different Bangladeshi study [33]. Premature newborns are more likely to develop sepsis because of their immature immune systems, which can impede their ability to respond to infectious agents. This risk is particularly high for premature children who need invasive treatments and must stay in the hospital for extended periods of time. Preeclampsia, mother urinary tract infection, low APGAR at 1 and 5 minutes, and the newborn's early death are all linked to sepsis. [34] Additionally, compared to full-term, normal birth weight infants, preterm neonates are said to have three to ten times greater rates of infections. Numerous researchers have found that a low birth weight is a significant neonatal risk factor that can result in neonatal sepsis. [20,23,35]

This study found that 30.0% of patients had H/O prelacteal feeding, 70.0% had 7.1% chlorohexidin administered, 10.0% of neonates required bag mask resuscitation at birth, and 20.0% of subjects had poor home cleanliness. These findings are in line with previous research [16,17,25,35,36].

Conclusion

Neonatal risk variables for developing early onset neonatal sepsis were prematurity, low birth weight, and prelacteal feeding, whereas mother risk factors included PROM > 18 hours, extended labor, and P/V examination more than three times.

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