Original Article

Prevalence and Outcome of Neonatal Sepsis at the Benue State University Teaching Hospital, Makurdi

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ABSTRACT

Sepsis is a major global health threat with a high incidence and mortality, particularly in low- and middle-income countries such as Nigeria. Infections in the newborn used to be the 3rd leading cause of neonatal morbidity and mortality in Nigeria, but recent surveys have shown that it is becoming a leading cause of mortality in newborns. Hence, this study was undertaken to determine the prevalence and outcomes of neonatal sepsis at the Benue State University Teaching Hospital, Makurdi. A cross-sectional study was conducted from November 2024 to August 2025, involving neonates presenting with symptoms suggestive of neonatal sepsis. Data was collected using an interviewer-administered questionnaire and analysed using IBM SPSS version 23. A total of 150 neonates were recruited, with a mean birth weight of 2.26±0.81kg. Of the 150 neonates, 52 (34.7%) were in-born neonates, while 98(65.3%) were out-born. The most frequently reported neonatal clinical features were: fever 81 (54.0%), fast breathing 53(35.3%), refusal to feed 34(22.7%), foetal distress 25 (16.7%), APGAR score <7, 23 (15.3%), hypothermia 21(14.0%), respectively. Seventy-four (49.3%) neonates had positive blood culture, with a prevalence of 49.3%. A total of 114 (76.0%) neonates were managed and discharged, while mortality occurred in 26 (17.3%). Neonatal sepsis remains a significant cause of preventable mortality that requires continual surveillance to achieve a reduction in line with the SDG 3.2 goal.

Keywords: Hospital, Neonatal, Outcomes, Risk factor, Sepsis

INTRODUCTION

The first 28 days of life – the neonatal period – are the most vulnerable times for a child's survival.[1] Children face the highest risk of dying in their first month of life, at a global rate of 18 deaths per 1,000 live births.[1] Globally, an estimated 2.5 million newborns died in the first month of life in 2018 – approximately 7000 every day and an estimated 15% of the neonatal deaths were due to sepsis.[1,2] Deaths due to neonatal causes alone constituted 33% of global child deaths in the year 2022.[3] Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.[4] Sepsis contributes significantly to preventable mortality and is the final common pathway to death for severe infectious diseases, including bacterial bloodstream infections, diarrheal disease, lower respiratory tract infections, malaria and systemic fungal infections.[2] Based on the timing of infection, neonatal sepsis has been classified into two categories: early onset sepsis (EOS – onset within the first 72 hours after birth) and late onset sepsis (LOS – onset occurring after the first 3 days after birth).[2] Early-onset

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infections are acquired before or during delivery (vertical mother-to-child transmission).[5] Late-onset infections develop after delivery from organisms acquired in the hospital or the community.[5] The age at onset depends on the timing of exposure and the virulence of the infecting organism.[5] Neonates with bacterial sepsis may have either nonspecific signs or focal signs of infection including temperature instability, hypotension, poor perfusion with pallor and mottled skin, metabolic acidosis, tachycardia or bradycardia, apnoea, respiratory distress, grunting, cyanosis, irritability, seizures, feeding intolerance, abdominal distension, jaundice, petechiae, purpura and bleeding.[5] WHO recommends that all cases of clinical signs of severe infection in young infants (aged 0–59 days) are treated in hospital with a 7–10 day course of injectable antibiotics.[6] Determining the causative organism and corresponding treatment with sensitive antibiotics remains the standard of care.[7] A rapid, accurate diagnosis of sepsis improves clinical outcomes and represents a priority for both surveillance and clinical management, particularly in at-risk patients.[2] Studies have shown that the highest incidence of neonatal sepsis occurs in preterm and low birth weight infants.[2] While survival of preterm infants is improving over time, neonates are particularly vulnerable to sepsis caused by health care-associated infections, especially in settings with low health care resources where the rates are highest.[2] Mortality rates in children younger than 5 years have reduced by half globally since 1990, but neonatal mortality rates remain high and far from the Sustainable Development Goal target of less than 12 deaths per 1000 livebirths by 2030.[8]

Sepsis contributes significantly to preventable mortality and is the final common pathway to death for severe infectious diseases.[2] Eighty-five percent of sepsis cases and 84.8% of sepsis-related deaths occurred in countries with low, low-middle, or middle sociodemographic indices, particularly in sub-Saharan Africa and South-East Asia.[2] According to available estimates, approximately 20% of all-cause global deaths are due to sepsis, disproportionately affecting neonates, pregnant or recently-pregnant women, and people living in low-resource settings.[2] In accordance with Sustainable Development Goal 3.2 target, reducing global and local mortality from infectious diseases, especially in fragile populations, builds upon our progress in preventing and treating sepsis effectively.[2]

Nigeria is the most populous country in Africa with one of the highest birth rates, one of the highest neonatal sepsis incidence rates and one of the highest mortality rates in the world.[9] About 7 million babies are born annually in Nigeria, of which 240,000 die in the first 28 days of life. Neonatal mortality contributes 32% to overall annual under-five deaths.[10,11] Eighty percent of these deaths are caused by complications related to prematurity, birth asphyxia and infections, most of which are preventable and treatable.[10] In Nigeria, neonatal sepsis was the third leading cause of neonatal mortality, but results of the recent verbal autopsy survey show that it is now the leading cause of neonatal mortality.[11,12] Reducing neonatal mortality due to neonatal sepsis aligns with the goal of the Nigeria Every Newborn Action Plan (NiENAP) which targeted reducing neonatal mortality to 15 deaths per 1000 live births by 2030.[10] Several studies have been carried out about neonatal sepsis in different locations across Nigeria and a meta-analysis conducted by Medugu *et al*, included a total of 5,114 studies, out of which 24, consisting of a total of 2,280 cases, were selected for final review.[9] Nine studies met the criteria for assessment of hospital-based incidence of neonatal sepsis, representing 31,305 hospital births, and the incidence of neonatal sepsis was 18.2/1000 livebirths, with a range from 7-55/1000 livebirths.[9] Bech *et al* in their systematic review and meta-analysis of studies done on neonatal sepsis, which included 36 studies with 23 605 patients from secondary or tertiary level of care facilities in 10 countries found that the significant risk factors for neonatal sepsis in Sub-Saharan Africa were resuscitation at birth, low birth weight (<1.5kg and 1.5–2.5kg), low Apgar score at the first and fifth minute, prematurity <37 weeks, no crying right after birth, male sex, prolonged labour, PROM, multiple digital vaginal examinations, meconium-stained amniotic fluid, intrapartum maternal fever, foul-smelling vaginal discharge and low socioeconomic status.[13] This study therefore sought to determine the prevalence, pattern of presentation,

risk factors, and outcomes of neonatal sepsis as seen at the Benue State University Teaching Hospital.

MATERIALS AND METHODS

This was a cross-sectional study carried out at the Special Care Baby Unit (SCBU) of the Department of Paediatrics, Benue State University Teaching Hospital, Makurdi, from November 2024 to August 2025. The Benue State University Teaching Hospital provides general care and specialist services for patients within the state and its surrounding communities, as well as serving as a referral centre. The Department of Paediatrics has a Special Care Baby Unit, with 10 neonatal incubators, 10 phototherapy units, oxygen concentrators, multiparameter monitors, Continuous Positive Airway Pressure (CPAP) machine and has an admission capacity for 32 neonates. The unit is headed by a consultant paediatrician and has several doctors and nurses who provide care to the neonates admitted into the unit. In the SCBU, babies admitted for neonatal sepsis receive empirical antibiotic therapy with ceftazidime and gentamicin as the first-line therapy. All the neonates (0–28 days) with risk factors and/or clinical signs and symptoms suggestive of sepsis at the time of admission were included in the study and samples for blood culture were collected following informed consent by the parents.[14] Neonatal sepsis was categorised according to the neonate's age at the onset of symptoms into early-onset sepsis (≤ 72 h) and late-onset sepsis (> 72 h).[2] Neonates with prior antibiotic use were excluded to minimise interference with laboratory results, as well as those whose parents refused consent. Neonates delivered at the hospital were designated 'in-born' neonates, while babies referred to the unit after delivery outside the hospital were designated out-born neonates. A duration of rupture of foetal membranes greater than 18 h prior to delivery was defined as 'prolonged rupture of membrane', and a duration of active labour greater than 12 h was defined as 'prolonged labour'.[5] Gestational age was determined from the last menstrual period and the new Ballard score.[15,16] Newborns with birth weight <10th percentile were classified as small for gestational age (SGA), those between 10th and 90th percentile as appropriate for gestational age (AGA) and those with birth weight >90th percentile as large for gestational age (LGA).[17] Neonates who met the criteria had 3ml of venous blood collected under aseptic procedure into the BD BACTEC™ Peds Plus™/F Culture vials and transported to the laboratory in plastic containers. Socio-demographic characteristics, other neonatal details (clinical features, sex, age at admission, weight at admission, place of birth) and details of perinatal events (including occurrence of prolonged rupture duration of foetal membrane, duration of labour, occurrence of pyrexia during labour, mode of delivery, place of antenatal care, and place of delivery) were collected using the study proforma. Data was analysed using IBM SPSS Statistics software version 23. Univariate analysis was done using tables and frequencies, while bivariate analysis was performed using the Chi-squared test, and the level of significance was set at $P < 0.05$. Ethical clearance was obtained from the BSUTH Health Research Ethics Committee (BSUTH/CMAC/HREC/101/V.III/XX).

RESULTS

A total of 150 neonates were recruited during the study period, with 74 positive blood cultures, giving a prevalence of 49.3%.

A higher proportion (n= 118, 78.7%) of the neonates were aged ≤3 days with a median age at admission of 1.31 days. The majority (n=96, 64.0%) of the neonates were males. The mean birth weight was 2.26±0.81kg, with the average number (n=75, 50.0%) of the neonates weighing 1.5-2.5kg. Of the 150 neonates, (n=52, 34.7%) were in-born, while 98(65.3%) were out-born. Over two-thirds (n=102, 68.0%) of the neonates were delivered via SVD, and 46 (30.7%) were delivered through caesarean section, as shown in Table 1.

The maternal mean age was 28.92±5.69 years, with a greater proportion (n=59, 39.3%) aged 31-40 years. The mean parity was 2.33±1.74, with a greater proportion (n=62, 41.3%) being para 1. A greater percentage (n = 117, 78.0%) were booked, and more than half (n = 77, 51.3%) of the mothers had secondary education, as shown in Table 2.

Out of 150 samples, 74 were culture-positive, with the majority (n=59, 67.6%) as early-onset sepsis, while 15 were late-onset sepsis. Most of the culture-

positive results were from out-born neonates(n=41) compared to inborn neonates (n=33). The majority of the culture-positive cases were delivered via spontaneous vertex delivery (n=46) compared to those delivered via caesarean section (n=27), and there was a statistically significant relationship between birth weight and culture result (p=0.007) as shown in Table 3.

The most frequently reported neonatal risk factors and clinical features included; foetal distress (n= 25,16.7%), APGAR <7 were (n=23, 15.3%), resuscitation at birth (n=19, 12.7%), invasive procedures (n=18, 12.0%), assisted ventilation (n=10, 6.7%), congenital anomalies (n=15, 10.0%), fever (n=81,54.0%), hypothermia (n=21, 14.0%), fast breathing (n=53, 35.3%), refusal to feed (n=34, 22.7%), excessive crying 14(9.3%) convulsions 14(9.3%) respectively and there was no statistically significant relationship between neonatal presentation and culture outcomes as shown in Table 4.

The commonly reported maternal risk factors were prolonged labour (>12 hours) (n=21, 14.0%), PROM (>24 hours) (n=33, 22.0%), intrapartum fever (n=18, 12.0%), UTI (n=10, 6.7%), but there was no statistically significant relationship between maternal factors and culture outcomes, as shown in Table 5

A total of 114 (76.0%) of the neonates were managed and discharged, while mortality occurred in 26 (17.3%) of the neonates, as shown in Figure 1.

Table 1: Neonatal characteristics (n=150)

Variables	Frequency	Percent
Age (in days)		
≤3	118	78.7
4 - 7	13	8.7
8 - 14	10	6.7
15 - 21	5	3.3
22 - 28	4	2.7
Median=1.31		
Sex		
Male	96	64.0
Female	54	36.0
Birth weight (in kg)		
<1	10	6.7
1 - <1.5	19	12.7
1.5 - 2.5	75	50.0
2.6 - 3.9	43	28.7
≥4	3	2.0
Mean=2.26±0.81		
Place of admission		
In-born	52	34.7
Out-born	98	65.3
Place of delivery		
Home	22	14.7
Hospital	123	82.0
TBA	2	1.3
Others	3	2.0
Mode of delivery		
SVD	102	68.0
Caesarean section	46	30.7
Assisted	2	1.3

Table 2: Maternal characteristics. (n=150)

Variables	Frequency	Percent
Age (in years)		
≤20	5	3.3
21 -25	39	26.0
26 -30	44	29.3
31 -40	59	39.3
41 -45	3	2.0
Mean=28.92±5.69		
Parity		
1	62	41.3
2	38	25.3
3	18	12.0
4	19	12.7
≥5	13	8.7
Mean=2.33±1.74		
Booking Status		
Booked	117	78.0
Unbooked	33	22.0
Mother's educational level		
Primary	25	16.7
Secondary	77	51.3
Tertiary	37	24.7
None	11	7.3
Religion		
Christianity	145	96.7
Islam	5	3.3
Mother's occupation		
Farmer	37	24.7
Civil servant	23	15.3
House wife	42	28.0
Trader	26	17.3
Artisan	11	7.3
Student	10	6.7
Lawyer	1	0.7

Table 3: Association between neonatal characteristics and culture results

Variable	Blood Culture		Test statistics $\chi^{2/f}$	p-value
	Negative n=76 n(%)	Positive n=74 n(%)		
Age (in days)			4.68	0.327
≤3	59(50.0)	59(50.0)		
4-7	5(38.5)	8(61.5)		
8-14	5(50.0)	5(50.0)		
15-21	3(^0.0)	2(40.0)		
22-28	4(100.0)	0(0.0)		
Sex			0.01	0.903
Male	49(51.0)	47(49.0)		
Female	27(50.0)	27(50.0)		
Birth weight (in kg)			13.95	0.007*
<1	8(80.0)	2(20.0)		
1 - <1.5	3(15.8)	16(84.2)		
1.5 - 2.5	38(50.7)	37(49.3)		
2.6 - 3.9	25(58.1)	18(41.9)		
≥4	2(66.7)	1(33.3)		
Place of admission			6.35	0.012
In-born	19(36.5)	33(63.5)		
Out-born	57(58.2)	41(41.8)		
Place of delivery			2.80	0.456
Home	9(40.9)	13(59.1)		
Hospital	63(51.2)	60(48.8)		
TBA	2(100.0)	0(0.0)		
Others	2(66.7)	1(33.3)		
Mode of delivery			2,56	0.266
SVD	56(54.9)	46(45.1)		
Caesarean section	19(41.3)	27(58.7)		
Assisted	1(50.0)	1(50.0)		
Multiple gestation			3.24	0.072
Yes	9(34.6)	17(65.4)		
No	67(54.0)	57(46.0)		

Table 4: Association between neonatal clinical features and blood culture results

Variable	Blood Culture		Test statistics $\chi^{2/f}$	p-value
	Negative n=76 n(%)	Positive n=74 n(%)		
Foetal distress			0.02	0.884
Yes	13(52.0)	12(48.0)		
No	63(50.4)	62(49.6)		
APGAR <7			1.13	0.287
Yes	14(60.9)	9(39.1)		
No	62(48.8)	65(51.2)		
Resuscitation at birth			0.03	0.855
Yes	10(52.6)	9(47.4)		
No	66(50.4)	65(49.6)		
Invasive procedures			2.09	0.148
Yes	12(66.7)	6(33.3)		
No	64(48.5)	68(51.5)		
Assisted ventilation			0.37	0.541
Yes	6(60.0)	4(40.0)		
No	70(50.0)	70(50.0)		
Congenital anomalies			0.10	0.744
Yes	7(46.7)	8(53.3)		
No	69(51.1)	66(48.9)		
Fever (>37.5^{0}C)			0.11	0.733
Yes	40(49.4)	41(50.6)		
No	36(52.2)	33(47.8)		
Hypothermia			1.23	0.267
Yes	13(61.9)	8(38.1)		
No	63(48.8)	66(51.2)		
Fast breathing (>60cpm)			0.00	0.960
Yes	27(50.9)	26(49.1)		
No	49(50.5)	48(49.5)		
Refusal to feed			0.09	0.763
Yes	18(52.9)	16(47.1)		
No	58(50.0)	58(50.0)		
Excessive crying			0.00	0.958
Yes	7(50.0)	7(50.0)		
No	69(50.7)	67(49.3)		
Convulsions			0.37	0.539
Yes	6(42.9)	8(57.1)		
No	70(51.5)	66(48.5)		

Table 5: Association between maternal risk factors and culture results

Variable	Blood Culture		Test statistics	p-value
	Negative n=76 n(%)	Positive n=74 n(%)	$\chi^{2/f}$	
Booking status			0.01	0.912
Booked	59(50.4)	58(49.6)		
Unbooked	17(51.5)	16(48.5)		
Intrapartum fever			0.19	0.658
Yes	10(56.6)	8(44.4)		
No	66(50.0)	66(50.0)		
Maternal UTI			0.00	0.965
Yes	5(50.0)	5(50.0)		
No	71(50.0)	69(49.3)		
Prolonged labour (>12 hours)			0.41	0.522
Yes	12(57.1)	9(42.9)		
No	64(49.6)	65(50.4)		
PROM (>24 hours)			0.01	0.912
Yes	17(51.5)	16(48.5)		
No	59(50.4)	58(49.6)		

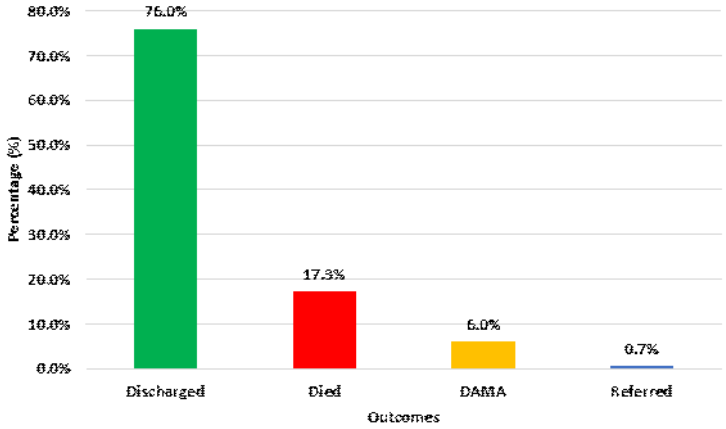

Figure 1: Bar chart showing outcomes of neonatal sepsis

DISCUSSION

The result of this study showed a prevalence of 49.3% for hospital-based culture-positive neonatal sepsis. This prevalence exceeds the previous reports by Olorukooba *et al*.[18] in Zaria (37.6%), Shobowale *et al,*[19] in Ogun (34%), Iregbu *et al,*[20] in Abuja (22%), Onyedibe *et al,*[21] in Jos (34.4%), Arowosegbe *et al,*[22] in Abeokuta (22.4%), Mokuolu *et al,*[23] in Ilorin (30.8%) Ihekaike *et al*,[24] in Jos and Mezgebu *et al* in Ethiopia.[25] This higher prevalence aligns with the 2019 verbal and social autopsy Study (VASA) report, with identified neonatal sepsis as a leading cause for neonatal morbidity and mortality.[12]

The prevalence of culture-negative sepsis in this study was higher than that of culture-positive sepsis, which is in line with previous reports by Karmila *et al*.[26] and Ahmed *et al*.[27] Culture-negative sepsis has been commonly reported, and neonates with culture-negative sepsis tend to be treated with antibiotics. Thus, culture-negative sepsis contributes to high antibiotic consumption in neonatal units. Antibiotics may be life-saving for the few truly infected infants; however, overuse of broad-spectrum antibiotics increases colonisation with antibiotic-resistant bacteria. Antibiotic therapy also induces perturbations of the non-resilient early-life microbiota, with potentially long-lasting negative impacts on the individual's own health.[28]

A wide range of conditions can mimic neonatal sepsis, including metabolic disorders, congenital viral infections, and other inflammatory conditions such as hypoxic ischemic encephalopathy and meconium aspiration syndrome.[29] Early recognition

of these conditions through clinical assessment, perinatal history, and other diagnostic tests can help prevent the overuse of antibiotics.[29]

Most cases of sepsis were noted to be early-onset sepsis with onset of symptoms within the first 72 hours of life based on the WHO classification. This finding was similar to the report of Ihekaike *et al*.[24], Milton *et al*,[30] and Uwe *et al*.[31] but contrary to the report of Samaha *et al,*[32] who reported more late-onset sepsis. The predominance of early-onset sepsis documented in this study may point to early identification and presentation, which provides an opportunity for early intervention.

Though most cases of neonatal sepsis were early-onset sepsis, they were mainly out-born babies and this aligns with the report of Ihekaike *et al*.[24] in Jos, Samaha *et al*,[32] in Zaria and Karmila *et al,*[26] in Indonesia. This predominance of out-born neonates with early onset neonatal sepsis points to a trend of early discharge from the hospital, as the majority of the neonates with sepsis in this study were delivered in a hospital.

Neonatal sepsis has a wide range of presentations, and this study also documented common presentations both in culture-positive and culture-negative cases. Neonates with sepsis in this study presented with symptoms such as fever, fast breathing, hypothermia, refusal to feed, convulsions, while maternal factors such as intrapartum pyrexia, urinary tract infections and prolonged rupture of membranes were also identified. These findings align with the documented features of sepsis reported in previous systematic reviews and meta-analyses of studies from sub-Saharan Africa.[13,33] Fever was the most common presenting feature in culture-positive cases, which is similar to the report by Ekwochi *et al*. from Enugu.[34]

Most cases of neonatal sepsis in this study were successfully managed and discharged, but there was 17.3% mortality for all cases. This mortality was higher than the reports of Samaha *et al*.[32] in Zaria, Ihekaike *et al,*[24] in Jos, and Shobowale *et al,*[19] in Ogun, but lower than the report of Arowosegbe in Abeokuta.[22]

CONCLUSION

Neonatal sepsis remains a significant cause of preventable mortality in Nigeria. The predominance of culture-negative sepsis calls for more surveillance and awareness to reduce unwarranted use of antibiotics in neonates presenting with fever.

Recommendations

1. Continued surveillance and awareness about neonatal sepsis as a cause of preventable mortality is recommended.
2. Increased awareness about culture-negative sepsis is recommended to reduce the unwarranted use of antibiotics in neonates.

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