Original Article

Short-term neurodevelopmental outcomes in neonates with perinatal asphyxia: Experience of a tertiary care hospital in Bangladesh

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ABSTRACT:

Background: *Perinatal asphyxia is one of the leading causes of neonatal mortality, ranking third after sepsis and prematurity. It is also a major contributor to childhood morbidity. However, the most concerning consequence is its impact on the brain, which can lead to long-term neurological impairment.*

Objective: *The objective of this study was to observe the short-term neurodevelopmental outcomes in neonates affected by perinatal asphyxia.*

Methodology: *This study was a prospective cohort study conducted at department of neonatology, Bangladesh Shishu Hospital & Institute (BSH&I) from January 2023 to December 2023; Total 429 newborn were screening among them 46 newborns with perinatal asphyxia fulfilling the inclusion criteria were included in the study. Inclusion criteria were; Term (37-41 week gestational age) and late preterm (34-36 week gestational age) newborns. Newborns satisfying the American Academy of Pediatrics/American College of Obstetrician criteria of perinatal asphyxia. Exclusion criteria were; Early preterm and Babies with an antenatally diagnosed significant congenital malformation or clinically suspected TORCH infection.*

Results: *Among 429 newborn babies 46 were found perinatal asphyxia and their prevalence rate was 10.7%. Regarding hospital outcomes, 39(84.8%) were discharged, while 7(15.2%) were expired. The duration of hospital stay varied, with 10 newborns (21.7%) staying for less than 7 days, 22 (47.8%) staying between 7-14 days, and 14 (30.4%) staying for more than 14 days. A significant association was found between the HIE stage and hospital outcomes ($p<0.05$). In majority cases (87.5%) low HINE scores were predominantly observed in HIE Stage III, while high scores were associated with HIE Stage I.*

Conclusion: *There is a significant association between the severity of Hypoxic-Ischemic Encephalopathy (HIE) and both neurological outcomes and hospital discharge status. Infant who presented with more severe brain injury at birth tended to have high risk of development of significant neurological impairment.*

Key Words:
Neurodevelopmental outcome, birth asphyxia, HIE stage.

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Introduction

Perinatal asphyxia, the commonest cause of neonatal hospital admission with involvement of majority of an infant's organs but brain impairment is particularly worrisome.1 Early, severe neurologic dysfunction indicates significant hypoxic-ischemic insult and is the best predictor of neurologic sequelae. The survivors suffer from hypoxic–ischemic brain injury affecting vulnerable areas of the brain leading to neurodevelopmental sequelae including problems with sensory-motor, auditory and language processing.1

Perinatal asphyxia is one of the predominant causes of neonatal mortality third only to sepsis and prematurity. It is also one of the leading causes of morbidity among children.2 Perinatal asphyxia is a significant global health challenge, contributing to an estimated 23% of neonatal deaths worldwide and a substantial burden of long-term disabilities.3 The incidence of term perinatal asphyxia is 2 per 1000 births in high resource countries. The rate is 10 times higher in countries with limited maternal and neonatal care access.4 Of those infants affected, 15% to 20% die in the neonatal period, and up to 25% of survivors are left with permanent neurologic deficits.5 Perinatal asphyxia can lead to a wide range of serious complications, affecting multiple organ systems. The brain is particularly vulnerable, often resulting in HIE, which can cause long-term neurological impairments such as cerebral palsy, developmental delays, and cognitive deficits. In severe cases, perinatal asphyxia may also lead to seizures, poor muscle tone, feeding difficulties, and death.6 The frequency of asphyxia is higher in preterm infants than in full-term infants and is inversely related to gestational age and birth weight. This study aims to provide an overview of the literature on short-term outcomes following perinatal asphyxia.

Materials and Methods

This study was a prospective cohort study conducted at department of neonatology, Bangladesh Shishu Hospital & Institute (BSH&I) from January 2023 to December 2023. Total 429 newborn were screening among them 46 newborns with perinatal asphyxia fulfilling the inclusion criteria were included in the study. Inclusion criteria were; Term (37-41 week gestational age) and late preterm (34-36 week gestational age) newborns. Newborns satisfying the American Academy of Pediatrics/American College of Obstetrician criteria of perinatal asphyxia. Exclusion criteria were; early preterm and babies with an antenatally diagnosed significant congenital malformation or clinically suspected TORCH infection.

All newborns late preterm and term, who experienced asphyxia upon delivery were enrolled in the study. Maternal profile and risk factors as well as intrapartum complications were also documented. The distinct newborn parameter at birth, the findings on detailed clinical examination as well as reports of investigations were documented. The neurological examination included a detailed assessment in the form of Sarnat and Sarnat system for Hypoxic Ischemic Encephalopathy. The newborns who survived and discharged went through baseline neurological, hearing as well as ophthalmological assessment. Neurological examination was done using Hammersmith Infant Neurological Examination (HINE), subsequent hearing assessment via OAE and BERA and visual evaluation up to 6 months of age during their follow up in the well-baby clinic and high-risk clinic. Continuous data was summarized as mean and standard deviation and categorial data was expressed as frequencies and percentages. Statistical analysis was done by using latest version of SPSS (Statistical package for social science). Chi square test was used to calculate between two groups, p value of less than 0.05 was considered significant.

Results

Total 429 babies conducted in the department of pediatrics of Bangladesh Shishu Hospital & Institute during 6 months follow up 46 babies were birth asphyxia and their prevalence rate of 10.7% (Table I).

Table I

Prevalence of birth asphyxia in neonatal word

	Number of patients
Total patients	429
Birth asphyxia	46
Percentage of birth asphyxia	10.7

Table II
Demographic variable of the study participant (n=46)

	Frequency	Percentage
Maternal age (years)		
≤20	5	10.9
21-30	38	82.6
>30	3	6.5
Sex of the babies		
Male	28	60.9
Female	18	39.1
Gestational age (weeks)		
<36	12	26.1
≥37	34	73.9
Birth weight (kg)		
<2.5	16	34.8
2.5-4.0	30	65.2
Mode of delivery		
Vaginal	31	67.4
Caesarean section	15	32.6
ANC		
Regular	19	41.3
Irregular	27	58.7
Malpresentation	3	6.5
PROM	14	30.4
PIH	14	30.4

Regarding the demographic and clinical profile, the majority of mothers were aged between 21–30 years (38 cases, 82.6%). Male newborns were predominant, accounting for 28 cases (60.9%). Most babies were delivered at a gestational age of ≥37 weeks (34 cases, 73.9%) and had a normal birth weight (30 cases, 65.2%). Vaginal delivery was the most common mode of delivery (31 cases, 67.4%). A total of 27 mothers (58.7%) had irregular antenatal care (ANC) visits. Among maternal complications, malpresentation was observed in 3 cases (6.5%), premature rupture of membranes (PROM) in 14 cases (30.4%), and pregnancy-induced hypertension (PIH) in 14 cases (30.4%) (Table II).

Table II
Demographic variable of the study participant (n=46)

	Frequency	Percentage
Outcome		
Discharged	39	84.8
Expired	7	15.2
Hospital stay (days)		
<7	10	21.7
7-14	22	47.8
>14	14	30.4

Regarding hospital outcomes, 39 newborns (84.8%) were discharged, while 7 (15.2%) unfortunately expired. The duration of hospital stay varied, with 10 newborns (21.7%) staying for less than 7 days, 22 (47.8%) staying between 7-14 days, and 14 (30.4%) staying for more than 14 days (Table III).

Table IV
Outcome with stage of HIE (n=46)

Stage of HIE	Total	Discharged n(39)	Expired n=7	p value
I	10	10 (25.64%)	0 (0.0%)	
II	22	21 (53.85%)	1 (14.29%)	0.002
III	14	8 (20.51%)	6 (85.71%)	
Total	46	39 (84.8%)	7 (100%)	

A significant association was found between the HIE stage and hospital outcomes ($p<0.05$). Among newborns with HIE Stage I, 10 cases (25.64%) were discharged. In HIE Stage II, 21 out of 22 cases (53.85%) were discharged, while 1 case (14.29%) resulted in death. In contrast, among those with HIE Stage III, only 8 cases (20.51%) were discharged, and 6 cases (85.71%) expired (Table IV).

Table V
HINES score of the study participant (n=39)

	Stage of HIE		
	I	II	III
	10	21	8
HINES score			
<6o	0 (0.0%)	5 (23.8%)	7 (87.5%)
60-70	0 (0.0%)	2 (9.5%)	1 (12.5%)
>70	10 (100.0%)	14 (66.7%)	0 (0.0%)
Visual impairment	0 (0.0%)	4 (19.0%)	4 (50.0%)
Hearing impairment	0 (0.0%)	1 (4.8%)	7 (87.5%)

The table indicates a clear correlation between HIE severity and neurological outcomes. Low HINE scores were primarily seen in HIE Stage III, whereas high scores were associated with HIE Stage I. Visual impairment was reported in 4 cases (19%) of HIE Stage II and 4 cases (50%) of HIE Stage III. Hearing impairment was noted in 4.8% of HIE Stage II cases and significantly increased to 87.5% (7 cases) in HIE Stage III (Table V).

Discussion

In this study prevalence of perinatal asphyxia was found 10.7%. In comparison, Parvin et al.7 reported that 11.93% had perinatal asphyxia. Additionally, perinatal asphyxia accounted for 16% of total under-five child mortality.8 According to Sinha et al.9 the incidence of perinatal asphyxia was 17.6 per 1,000 live births.9

This study showed that, regarding demographic and clinical profiles, the majority of mothers were aged between 21 and 30 years (38 cases, 82.6%). Male newborns predominated, accounting for 28 cases (60.9%). Most babies were delivered at a gestational age of ≥37 weeks (34 cases, 73.9%) and had normal birth weight (30 cases, 65.2%). Vaginal delivery was the most common mode of delivery (31 cases, 67.4%). A total of 27 mothers (58.7%) had irregular antenatal care (ANC) visits. Among maternal complications, malpresentation was observed in 3 cases (6.5%), premature rupture of membranes (PROM) in 14 cases (30.4%), and pregnancy-induced hypertension (PIH) in 14 cases (30.4%). These findings are consistent with Njinkui et al.10 who reported males as the most represented (59%), with the majority born at term (79%) and having birth weights between 2500–4000 grams (69%). Similar observations were also reported by Ansari et al.1

Regarding hospital outcomes, 39 newborns (84.8%) were discharged, while 7 (15.2%) unfortunately died. The duration of hospital stay varied: 10 newborns (21.7%) stayed less than 7 days, 22 (47.8%) stayed between 7 and 14 days, and 14 (30.4%) stayed more than 14 days. Njinkui et al.10 reported that among 1,624 neonates hospitalized during their study period, 277 were treated for neonatal asphyxia, including 58 participants, of whom 7 (12%) died. Nearly half of their patients had a hospital stay between 7 and 14 days. Sinha et al. observed a mortality rate of 26% in severely birth asphyxiated (SBA) babies versus 8.6% in moderately birth asphyxiated (MBA) babies ($p<0.001$). The mean hospital stay was also longer in severely asphyxiated infants compared to moderately asphyxiated infants (14.08 days vs. 8.66 days).9

This study found a significant association between HIE stage and hospital outcomes ($p<0.05$). Among newborns with HIE Stage I, 10 cases (25.64%) were discharged. In Stage II, 21 out of 22 cases (53.85%) were discharged, while 1 case (14.29%) died. In contrast, Stage III showed a high mortality rate, with only 8 cases (20.51%) discharged and 6 cases (85.71%) expired. Comparatively, Ansari et al.1 reported that among 56 newborns with Stage I HIE, 55 (98.2%) were discharged and only 1 (1.8%) died. In Stage II, 27 out of 29 cases (93.1%) were discharged, with 2 (6.9%) mortalities. For Stage III, mortality was high with 57 out of 65 cases (87.7%) dying, and only 8 (12.3%) discharged. Overall, 90 babies were discharged, with deaths predominantly occurring in Stage III HIE cases. Sinha et al. reported that all babies with severe birth asphyxia had some grade of HIE, while 5.1% of those with moderate birth asphyxia did not develop HIE. Stage III HIE was observed in 26.9% of severe birth asphyxia cases compared to 8.6% in moderate cases ($p = 0.064$).9

This study demonstrates a clear correlation between the severity of Hypoxic Ischemic Encephalopathy (HIE) and neurological outcomes. In majority cases (87.5%) low HINE scores were predominantly observed in HIE Stage III, while high scores were associated with HIE Stage I. Infant who had more severe brain injury at birth tended to have low HINE score reflects high risk of development of significant neurological impairment. Visual impairment was reported in 4 cases (19%) of HIE Stage II and 4 cases (50%) of HIE Stage III. Hearing impairment was noted in 4.8% of HIE Stage II cases, increasing significantly to 87.5% (7 cases) in HIE Stage III.

Ansari et al.1 reported follow-up HINE scores above 65 in 96%, 81%, and 35% of cases across the three advancing HIE stages, respectively. All 54 Stage I HIE cases had normal vision on follow-up. In Stage II, 6 out of 26 cases (23.1%) showed vision abnormalities, while 20 (76.9%) had normal vision. Among Stage III cases, vision impairment was seen in 4 (50%) with the remaining 4 (50%) maintaining normal vision. Thus, ophthalmological assessments were normal in all Stage I babies, two-thirds of Stage II, and half of Stage III babies. Regarding hearing, all 54 Stage I cases had normal assessments. In Stage II, 25 out of 26 cases (96.2%) showed normal hearing, while 1 case (3.8%) had impairment. Hearing abnormalities were present in all Stage III cases, indicating 100% abnormal hearing screening in this group.1

Romeo et al. studied optimality scores and found that infants with suboptimal scores below 67 were consistently associated with motor impairments. Previous research

indicated that global HINE scores under 56 and 65 predicted a high probability of cerebral palsy (CP) at 3 and 12 months, respectively. However, the sensitivity for identifying only severe CP using HINE scores is low.11

Visual outcomes in HIE stages align with findings by Salati et al.12 who reported 63.1% of cases exhibiting visual impairments in acuity, ocular motility, and fundus findings. Azzopardi et al.13 reported 10% visual impairment or blindness using subjective assessment tools. Similar degrees of visual impairment have been documented in multiple studies. Auditory impairment severity correlated with asphyxia severity, consistent with Fitzgerald et al.14's findings. Michniewicz et al.15 reported sensorineural bilateral hearing impairment in 8.2% of infants followed up. Hamed et al.16 found a significant association between permanent hearing loss and HIE cases complicated by persistent pulmonary hypertension of the newborn (PPHN). Sinha et al.9 observed that at 3 months, 96.2% of babies with severe asphyxia failed transient distortion product otoacoustic emissions screening (TDSC), 88.5% had post-discharge seizures, and 92.3% exhibited tone abnormalities, all significantly higher than in moderate asphyxia cases. Njinkui et al.10 reported neurodevelopmental abnormalities in 25.5% of patients, including gross motor delay (mainly tetraparesis) in 23.5%, fine motor delay in 27.5%, impaired social contact in 31%, and speech/language delay. Despite this, the majority (78.4%) had a normal developmental quotient. Padman et al. identified sensory impairments in 18% of infants, including 10% with visual deficits and 8% with auditory impairments. Severe HIE was a significant predictor of poor neurodevelopmental outcomes (OR: 3.5; 95% CI: 2.1–5.8).17

Conclusion

There is a significant association between the severity of Hypoxic-Ischemic Encephalopathy (HIE) and both neurological outcomes and hospital discharge status. Newborns with milder HIE (Stage I) demonstrated higher discharge rates and better neurological function, as indicated by higher HINE scores. In contrast, those with severe HIE (Stage III) exhibited lower discharge rates, higher mortality, and increased rates of visual and hearing impairments.

Conflict of Interest: None

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