



## Original Research Article

## Contributing factors, complications and immediate outcome of birth asphyxia in a tertiary care centre in Assam

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## ARTICLE INFO

## Article history:

Received 16-02-2023

Accepted 30-03-2023

Available online 07-12-2023

## Keywords:

Birth asphyxia  
contributing factors  
complication  
outcome  
Assam

## ABSTRACT

**Background:** Birth asphyxia is defined by the World Health Organization as the failure to initiate and sustain breathing at birth. Etiological factors include maternal factors like hypertension, chorioamnionitis, diabetes, maternal pulmonary or cardiac disorders, placental factors like abnormal placentation, abruption, infarction, hydrops, uterine rupture, umbilical cord prolapse, entanglement, true knot, compression, abnormalities of blood vessels, fetal factors like anemia, cardiomyopathy, infections, hydrops, neonatal factors like cyanotic congenital heart disease, persistent pulmonary hypertension of the newborn, respiratory failure due to meconium aspiration syndrome, congenital pneumonia, pneumothorax etc.

**Aim:** To study the contributing factors, complications and immediate outcome of birth asphyxia in a tertiary care centre in Assam.

**Materials and Methods:** It was a prospective observational study carried out in NICU, Gauhati Medical College & Hospital, Guwahati, Assam. The study included clinical profile of 200 cases of birth asphyxia admitted to the above center during period of one year starting from 1st of August 2021 to 31<sup>st</sup> July 2022.

**Results:** In our study, out of 200 neonates, 102(51%) were male and 98(49%) were female. 161 cases (80.5%) were term. 115 mothers (57.5% were primigravida and 85 mothers (42.5%) were multigravida. Various antenatal contributing factors were found to be meconium stained liquor (68%), anemia (57%), pregnancy induced hypertension (15%), prolonged labor (28.5%), fever(5%), antepartum haemorrhage (5.5%), chorioamnionitis (5%). Various complications of birth asphyxia observed in the study were hyperbilirubinemia 76 cases (38%), hypocalcemia 46 cases (23%), shock 31 cases (15.5%), DIC(13%), meconium aspiration syndrome 24 cases (12%), hypoglycemia 15 cases(7.5%), sepsis 13 cases (6.5%), apnea 14 cases (7%), Necrotising Enterocolitis 6 cases (3%), AKI 120 cases (60%) and the total mortality percentage was 26%.

**Conclusion:** Birth asphyxia is a leading cause of mortality among the newborn. The contributing factors needs to be addressed at the earliest to decrease the mortality and morbidity due to birth asphyxia.

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### 1. Introduction

Birth asphyxia is defined by the World Health Organization (WHO) as ‘the failure to initiate and sustain breathing at birth’.

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#### 1.1. According to NNPD network

1. Moderate perinatal asphyxia : slow /gaspng breathing or an APGAR Score of 4 to 6 at 1 min.
2. Severe perinatal asphyxia: no breathing or an APGAR score of 0 to 3 at 1min of age

## 1.2. American academy of Paediatrics and American college of Obstetrics and Gynecology

1. Profound metabolic or mixed acidemia pH < 7 in umbilical cord blood.
2. Persistence of low APGAR score of less than 3 for more than 5 minutes.
3. Signs of neonatal neurological dysfunction (e.g. seizure, encephalopathy, tone abnormalities).
4. Evidence of multiple organ involvement (kidney, heart, liver, lung, intestine).

It is a major contributor to neonatal mortality worldwide causing 15% of all neonatal deaths in India.<sup>1</sup> Almost all asphyxia related deaths (98%) occur during the first week of life.<sup>2</sup> The incidence of perinatal asphyxia is two per 1000 births in developed countries, but the rate is up to 10 times higher in developing countries where there may be limited access to maternal and neonatal care. Of those infants affected, 15-20% die in the neonatal period, and up to 25% of survivors are left with permanent neurologic deficits.<sup>3</sup> The study aims at reviewing the current incidence rate of birth asphyxia in NICU, Gauhati Medical college and hospital, its correlation in an attempt towards better understanding of the disease process and contributing towards improved survival and a better quality of life.

Hypoxic ischemic encephalopathy is the clinical evidence of encephalopathy, that is abnormal neurobehavioral state consisting of an altered level of consciousness with objective data to support a hypoxic ischemic mechanism as the underlying cause of encephalopathy.<sup>4</sup>

Etiological factors are multiple and include maternal factors like hypertension, chorioamnionitis, diabetes, maternal pulmonary or cardiac disorders, placental factors like abnormal placentation, abruption, infarction, fibrosis or hydrops, uterine rupture, umbilical cord prolapse, entanglement, true knot, compression, abnormalities of blood vessels, fetal factors like anemia, cardiomyopathy, infections, hydrops, severe cardiac insufficiency, neonatal factors like cyanotic congenital heart disease, persistent pulmonary hypertension of the newborn, respiratory failure due to meconium aspiration syndrome, congenital pneumonia, pneumothorax etc.

## 2. Materials and Methods

The study was a hospital based cross-sectional observational study carried out for a period of 1 year from 1<sup>st</sup> August 2021 to 31<sup>st</sup> July 2022 in neonates delivered in Gauhati Medical college and hospital admitted to the Neonatal Intensive Care Unit Gauhati Medical College & Hospital, with clinical features suggestive of birth asphyxia.

## 2.1. Inclusion criteria

Inborn babies with

1. Gestational age: >28 weeks.
2. Apgar score <7 at 1 min.

## 2.2. Exclusion criteria

1. Newborn with congenital malformation.
2. Gestational age <28 weeks.
3. Newborn delivered outside GMCH.

The study included 200 neonates admitted for birth asphyxia in the inborn unit of NICU, GMCH who fulfilled the inclusion criteria and whose parents agreed to give consent to participate in the study after proper explanation selected randomly. Neonates who did not fulfill the inclusion criteria were excluded from the study. The disease process and the importance of the study was explained to the parents. Informed consent of the parents was obtained in a printed consent form in both English and Assamese language. The examining physician explained any kind of questions or doubts to the parents in Assamese language and the signature of the parent or the left thumb impression was taken. Institutional ethics committee clearance was obtained. A detailed relevant antenatal history was elicited in a pre-structured set of questions in a proforma and relevant routine investigations were done to study the complications. Birth asphyxia was defined on the basis of APGAR scoring done at the time of delivery at 1 min and 5 min. Maternal antenatal history was elicited from both the parents as well as the records in the mother's file after taking proper approval from the department of obstetrics and gynaecology. Gestational age was calculated from maternal LMP or New Ballard score (NBS) was done if it was not available. Birth weight was taken in an electronic weighing scale with an accuracy of  $\pm 5$  gm and appropriateness of weight, small for gestational age or large for gestational age was determined by plotting weight in intrauterine growth chart. The neonates identified as cases were shifted to Neonatal Intensive care for observation and management according to unit protocol. Neonates were followed up till discharge and all data recorded in a predesigned proforma.

The baby was evaluated and observed for complications like hypoxic ischemic encephalopathy (HIE), acute kidney injury (AKI), disseminated intravascular coagulation (DIC), apnea, hypoglycaemia, hypocalcemia, hyperbilirubinemia etc. HIE was staged according to Levene grading of hypoxic ischemic encephalopathy. Relevant investigations were sent which included sepsis screen consisting of leucocyte count, absolute neutrophil count, band neutrophilic ratio, serum electrolytes ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{++}$ ,  $\text{Ca}^{++}$ ), serum urea, serum creatinine, total serum bilirubin, blood culture if indicated. Bedside USG was done if indicated.

### 3. Results and Observations

During our study period, 200 cases of birth asphyxia cases delivered in GMCH with gestation age >28 weeks without any congenital malformation and APGAR score of less than 7 at 1 min were taken for study. Out of 200 cases, 102 cases were male and 98 cases were female. Most of the pregnancies were booked cases (184 cases out of 200) Amongst, the mother, 55 were less than 21 years, 22 were 26 to 30 years old (118) belonged to 21 to 25 years and 5 were more than 30 years old. In our study, most of the babies were term (122; 61% term baby). 13 babies were less than 34 weeks. 65 babies were between 34 to 37 weeks old and 122 babies were 38 to 42 weeks old. Most babies (149) weighed 2.5 kg or more. 42 were low birth weight babies, 7 were very low birth weight babies and 2 were extremely low birth weight babies. In our study, most of the cases were delivered by emergency cesarean section. 128 by LSCS, 58 cases by NVD and 14 cases by AVD. Most of the mothers were primigravida (57.5%) and 42.5% were multigravida. Out of 200 cases, 148 were discharged and 52 expired which gives a mortality percentage of 26%. Most of the babies (136) were appropriate for date, 58 cases were small for date and 6 cases were large for date babies. In our study, the abnormal ultrasonography findings were recorded in 99 cases which include fetal bradycardia (39 cases), oligohydramnios (35 cases), cord around the neck (10 cases), reverse end diastolic flow (6 cases) and absent end diastolic flow (9 cases). The various antenatal risk factors observed in our study are maternal fever (10 cases), chorioamnionitis (10), PIH (30), meconium stained liquor (136), prolonged labour (57), antepartum hemorrhage (11), PROM (46) and anemia (114) and tight nuchal cord (10). Among the cases 29 mothers were suffering from hypothyroidism, 9 cases had diabetes mellitus and 4 cases had chronic hypertension.

The various complications of birth asphyxia observed in our study are hyperbilirubinemia (38%), AKI (60%), HIE (57%), meconium aspiration syndrome (12%), DIC (13%), sepsis (6.5%), hypoglycemia (7.5%), apnea (7%), NEC (3%) and hypocalcemia (23%) and shock (15.5 %). In our study, out of 200 cases hypocalcemia was observed in 46 cases (23%). Greater the severity of asphyxia (lower APGAR Score) more the cases of hypocalcemia were observed. Severe birth asphyxia is defined as APGAR score of 0 to 3 at 1 min and mild to moderate birth asphyxia defined as APGAR score of 4 to 6 at 1 min. With increasing severity more number of hypocalcemia cases were observed. Out of 200 cases, 120 cases of acute kidney injury were observed with rise in creatinine of more than or equal to 0.3 mg/dl from baseline within 48 hours or percentage increase of more than or equal to 50% from baseline in last 7 days. With increasing severity of birth asphyxia number of cases of acute kidney injury shows a positive correlation. In our study total 114 cases of HIE were noted out of 200. With increasing severity of birth asphyxia

as evident by low APGAR Score, grading of HIE increases as evident by p value. Mild to moderate birth asphyxia is defined as APGAR score of 4 to 6 at 1 min and severe birth asphyxia is defined as APGAR score 0 to 3 at 1 min. 115 cases had severe birth asphyxia and rest 85 had mild to moderate birth asphyxia.

**Table 1:** Various antenatal risk factors in the mothers

	Antenatal factors	Percentage
Fever	10	5
Antepartum Hemorrhage	11	5.5
PIH	30	15
Chorioamnionitis	10	5
Prolonged labour	57	28.5
Meconium stained amniotic fluid	136	68
PROM	46	23
Anemia	114	57
Nuchal cord	10	5

**Table 2:** Complications of birth asphyxia

	Frequency	Percentage
Hyperbilirubinemia	76	38
DIC	26	13
Shock	31	15.5
Meconium aspiration syndrome	24	12
Sepsis	13	6.5
Hypoglycemia	15	7.5
Apnea	14	7
Necrotising Enterocolitis	6	3
Hypocalcemia	46	23
HIE	114	57
Acute Kidney Injury	120	60

**Table 3:** Correlation of birth asphyxia with acute kidney injury

Acute kidney injury	Severe birth asphyxia	Moderate birth asphyxia	P value
Absent	38	42	0.02
Present	77	43	

**Table 4:** Comparing hypocalcemia with birth asphyxia severity

Birth asphyxia severity	Normal calcium	Hypocalcemia	P value
Severe birth asphyxia	78	37	0.001
Mild to moderate birth asphyxia	76	9	

**Table 5:** Comparison of HIE with severity of birth asphyxia

	Severe birth asphyxia	Moderate birth asphyxia	P Value
HIE None	25	60	0.001
HIE I	16	19	
HIE II	18	4	
HIE III	56	2	

#### 4. Discussion

The study was conducted in the NICU, department of Pediatrics, Gauhati Medical College and Hospital, Guwahati, involving 200 cases of birth asphyxia delivered in GMCH and admitted in the inborn unit NICU. From the data available in the indoor register, total number of babies admitted in inborn unit of GMCH is 5534 during our one year study period. The total number of babies admitted for birth asphyxia was 526 and which gives an incidence rate of 9.5%. Siva Saranappa S B et al in 2015,<sup>5</sup> Akangsha Muvel in 2019,<sup>6</sup> Avinash Sunny et al in 2021<sup>7</sup> got an incidence of 5.19%, 56% and 6% respectively. Whereas in our study incidence was 9.5%. This can be explained from the improving quality of maternal health facilities and improvement in quality of antenatal care in the recent years.

Kriti Mohan et al in 2013,<sup>8</sup> Babu BVA et al in 2014<sup>9</sup> and DR Murchana in 2020 got a mortality rate of 23.3%, 17.8% and 15.6% respectively. In our study group of 200 patients 148 patients were discharged and 52 expired which gives a mortality percentage of 26%. This higher mortality percentage can be explained from the fact that most of the pregnant mother are referred from the periphery to tertiary center at the critical stage leading to poor outcome. Male : female ratio in our study was 1.04:1 which is comparable to other studies done by Siva Saranappa S B et al in 2015,<sup>5</sup> Abebe Alemu et al in 2017 etc. In 2013, Ekta A Dalal et al<sup>10</sup> observed in their study that 79.8% were full term babies and 20.2% were preterm babies. In our study 162(81%) were term and 38(19%) were preterm(less than 37 completed weeks) and it is comparable to previous studies.

Abebe Alemu et al<sup>11</sup> in 2017 observed that 45 (17.6%) of newborns were low birth weight. Gdiom Gebreheat et al<sup>12</sup> in 2018 observed that neonates who weighed less than 2.5 kg are 12.75 times more likely to have perinatal asphyxia than those who are weighed 2.5-4 kg. In our study, 74.5% were more than or equal to 2.5 kg and 25.5% were low birth weight. In our study, 68% were appropriate for date, 29% were small for date and 3% were large for date. We found that 60% belonged to 21 to 25 years age group and 29% belong to less than 21 years

The important antenatal abnormal findings we got in our study are oligohydramnios, reverse end diastolic flow, fetal bradycardia, absent end diastolic flow, cord around the neck. Other studies have recorded oligohydramnios and nuchal

cord as important risk factor. In 2013, Ekta A Dalal et al<sup>10</sup> observed 41.9% of the study population had antenatal care. David R. Hall et al<sup>13</sup> in 1996 found that 91 per cent booked cases had satisfactory antenatal clinic attendance. In our study 92% cases were booked. Antepartum haemorrhage was found in 10% in a study done by G. I. Mcgil Ugwu et al<sup>14</sup> in 2012 and in 6.9% cases in a study done by Babu BVA et al<sup>9</sup> in 2014 whereas in our study antepartum hemorrhage was seen in 5.5% mothers. In our study we got maternal history of pregnancy induced hypertension in 15% cases. The findings of our study are comparable to previous studies done by Siva sarnappa et al in 2015 and Wubet Alebachew Bayih et al<sup>15</sup> in 2020. In our study 14.5% of the mothers were hypothyroid, 4.5% had diabetes mellitus and 2% were having hypertension

Gdiom Gebreheat et al<sup>12</sup> in 2018 noted that neonates born with cesarean section are seven times more likely to have perinatal asphyxia than those who are born spontaneously through the vaginal route. Similar results were also obtained in our study with 64% cases delivered by LSCS, 29% delivered by normal vaginal delivery and 7% delivered by assisted vaginal route. The higher percentage of LSCS can be explained from the fact that pregnant mothers are referred from the periphery at the critical period with fetal distress thus ending in emergency cesarean section.

In our study 68% of the babies were born with meconium stained amniotic fluid which is comparable to the results obtained by Ekta A Dala et al<sup>10</sup> in 2013 and siva saranappa et al<sup>5</sup> in 2015. Prolonged labor was found to be an important risk factor by many authors like David R. Hall e al<sup>13</sup> in 1996, (49 per cent), G. I. Mcgil Ugwu et al<sup>14</sup> in 2012 (51%), Ritbano Ahmed Abdo et al<sup>2</sup> in 2019. In our study prolonged labor was seen in 29% cases which is comparable to other studies. Siva Saranappa S B et al in 2015 observed that 11.6% had PROM. Wubet Alebachew Bayih et al<sup>15</sup> in 2020 found (16.8%) premature rupture of membrane cases among babies with birth asphyxia. In our study 23% of the mothers had PROM. Abebe Alemu et al<sup>11</sup> in 2017 and Hafiz Muhammad Aslam<sup>16</sup> 2013 noted anemia to be an important risk factor. In our study maternal anemia was found to be an important antenatal risk factor which accounted for 57% cases.

In our study Acute Kidney Injury was found in 60% cases which is comparable to studies done by Girish Gopal et al<sup>17</sup> in 2014; 64% cases, Saurabh et al<sup>18</sup> in 2018 ; 75% cases, Akangsha Muvel et al<sup>6</sup> in 2019 ;56% cases. In our study we observed HIE in 57 % cases. 18% had HIE I, 11% had HIE II and 28% had HIE III. The result of present study is comparable to previous studies done by Shazia Memon et al, Seema Shah et al<sup>19</sup> in 2014, Siva Saranappa in 2015, Paresh Kumar A. Thakkar et al in 2016.<sup>20</sup>

In a study published by Seema Shah et al<sup>21</sup> in 2014, the mean APGAR score in asphyxiated babies was 3.62 and 5.12 at 1 min and 5 min respectively. The APGAR

score showed decreasing trend with the increasing severity of HIE. 4.56 in non-HIE versus 3.12 in HIE III at 1 min and 5.84 in non-HIE versus 4 in HIE III at 5 min. We have also got a p value suggestive of similar result of increasing severity of HIE with decreasing APGAR score.

Babu BVA et al<sup>9</sup> in 2014 observed apnea to be (14.3% and necrotizing enterocolitis (NEC) (7.7%). Kriti Mohan et al<sup>8</sup> found hyperbilirubinemia (40%), respiratory distress (33%), apnea (23%) shock (20%), DIC (13%), Cyanosis (13%) meconium aspiration syndrome (10%) acute renal failure (6%) and necrotizing enterocolitis (6%) as important complications. In our study we got complications as 7% apnea, 7.5% hypoglycaemia, 3% NEC, 6.5% sepsis, 12% meconium aspiration syndrome, 15.5% shock, 13% DIC, 38% hyperbilirubinemia and 57% HIE and 60% AKI.

## 5. Conclusion

Birth asphyxia is a leading cause of mortality among the newborn. Various contributing factors like meconium stained liquor, maternal anemia, pregnancy induced hypertension, prolonged labor, anemia, PROM, cord around the neck chorioamnionitis needs to be addressed at the earliest to decrease the mortality and morbidity due to birth asphyxia. Most of the babies in the study were delivered by emergency cesarean section. A lot of effort need to be put up both in periphery to ensure better care of the pregnant women to decrease the complications of pregnancy and also in tertiary care centers so that emergency referral cases can be dealt with most efficient way to improve the outcome of pregnancy. In a limited period of 1 year all the complications could not be studied in detail. A more detailed study would have resulted in better understanding of the disease. For better understanding of the disease and complications, a long term follow up of the cases should have been done which was not possible within a limited period of 1 year.

## 6. Conflict of Interest

The authors do not have any conflicts of interest.

## 7. Source of Funding

None.

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**Cite this article:** Medhi G, Devi P, Deka B, Das H, Barman D, Bhoktiari M. Contributing factors, complications and immediate outcome of birth asphyxia in a tertiary care centre in Assam. *Panacea J Med Sci* 2023;13(3):571-576.