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Research Article

ASSOCIATED FACTORS AND IMMEDIATE OUTCOME IN BIRTH ASPHYXIATED TERM NEONATES ADMITTED IN TERTIARY CARE HOSPITAL IN TRIBAL REGION OF INDIA-AN OBSERVATIONAL STUDY

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ABSTRACT

Objectives: *The* objective *is to* study the associated risk factors and outcomes of birth asphyxia (BA).

Methods: The study involved 240 neonates of both genders who were admitted to the NICU of the Department of Pediatrics at NAMO MERI and SVBCH Hospital. Relevant information such as neonatal information, maternal information, and problems during pregnancy or labor noted and analyzed.

Results: Among the cases and controls, the male-to-female ratio was 1.3:1 and 1.09:1, respectively. The incidence of meconium-stained liquor was higher in some cases, and these infants required longer resuscitation compared to controls ($p<0.0001$). Maternal risk factors such as hypertension, antepartum hemorrhage, and prolonged second stage of labor were significantly associated with BA ($p<0.05$). In addition, BA was significantly associated with hypoxic-ischemic encephalopathy (HIE), convulsions, and apnea ($p<0.05$). Top of FormBottom of FormThere was a significant correlation between the duration of resuscitation and the grade of HIE in asphyxiated babies ($p<0.05$). A severe form of HIE was developed in cases with a longer duration of resuscitation. The duration of resuscitation was longer in patients who were delivered in either a primary health center or home compared to a tertiary care hospital ($p<0.05$).

Conclusion: Effective post-delivery resuscitation, additional basic steps, and training health workers and a skilled person at every birth can help reduce the occurrence of BA and its complications in resource-limited peripheral systems. This study highlights importance of maternal risk factor assessment, prompt resuscitation.

Keywords: Birth asphyxia, Hypoxic-ischemic encephalopathy, Neonatal mortality, Neonatal morbidity, Resuscitation, Maternal risk factors.

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INTRODUCTION

Birth asphyxia (BA) is a critical condition where newborns fail to initiate or maintain adequate respiration after delivery, leading to severe impairment of gas exchange. This is a significant cause of neonatal morbidity and mortality, particularly in low-resource regions. In general, in such areas, BA is diagnosed based on the inability to start or maintain spontaneous breathing at birth, indicated by a one-minute Apgar score of <7 [1-3].

In contrast to low-resource settings, BA in resource-replete settings is defined based on biochemical changes due to impaired gas exchange resulting from placental blood flow interruption. This leads to progressive hypoxemia, hypercapnia, and acidosis. BA diagnosis in these settings is confirmed by detecting fetal acidosis in umbilical cord arterial blood after delivery [1-3].

Every year, around 10–15 million neonates worldwide require resuscitation as they do not cry or breathe at birth. Timely and proper resuscitation is essential for their transition from intrauterine to extrauterine life. Failure to provide appropriate resuscitation can lead to death, brain injury, and long-term disabilities [4-8].

Survivors of BA are at risk of developing neurological complications, including developmental delay, cerebral palsy, and epilepsy, resulting in a significant burden on families and society. In countries like India, where BA is prevalent, understanding its pathophysiology and associated risk factors is crucial [3].

Despite the high prevalence of BA in tribal areas, there is a lack of studies on this condition. Thus, this study aimed to identify associated risk factors and outcomes. By understanding these factors, effective prevention and management strategies can be developed to reduce the burden of BA in these areas.

METHODS

Study setting and population

This study includes 240 neonates of both genders who were admitted to SVBCH Hospital NICU in the neonatal unit of the Department of Pediatrics, NAMO Medical Education and Research Institute, and SVBC hospital, located in Silvassa Union territory of DNH and DD, India, from August 2021 to August 2022. The hospital mainly serves the tribal population and has a 40-bedded Level 3 NICU setup.

Inclusion criteria

The inclusion criteria for this study included all newborns who were admitted to SVBCH Hospital with a gestational age of 37 weeks or more and diagnosed with BA. The study also included controls, who were selected randomly from non-asphyxiated NICU admissions with the same gestational age. The objective was to compare the associated risk factors and outcomes of BA in the study group with those of the control group.

Exclusion criteria

Neonates with congenital anomalies or syndromes, such as neural tube defects or congenital heart disease, were excluded from the study. In addition, neonates with a gestational age <32 weeks were also excluded from the study. These exclusion criteria were applied to ensure that the study population was representative of neonates with BA without any significant comorbidity that could affect the outcomes of interest.

Data collection

The study utilized a pre-structured data collection format to gather relevant information on neonatal and maternal factors. Neonatal information such as sex, birth weight, gestational age, and APGAR score, and maternal information such as age, parity, residence, place and mode of delivery, and any complications during pregnancy or labor were obtained. To ensure data accuracy and reliability, the research team underwent rigorous training on data collection techniques. The collected data were regularly monitored and cross-checked for consistency and completeness. Careful and diligent data collection is essential in producing reliable research findings, and the study team took significant steps to achieve this.

Data analysis

The collected data were entered into the Statistical Package for the Social Sciences version 20. Appropriate statistical tests such as Chi-square test, t-test, and ANOVA test were performed to analyze the data. The statistical significance of the results was determined using a $p<0.05$. The data analysis was conducted with utmost accuracy and precision to ensure that the findings of the study were reliable and could be used to make informed decisions.

Ethical considerations

This study obtained ethical clearance from the Institutional Ethical Committee, NAMO MERI SILVASSA. Confidentiality of the patients was maintained, and the data collected was only accessible to the investigators and authorized personnel.

RESULTS

In the study period, out of 8498 live births, 294 full-term deliveries were diagnosed with BA, resulting in an incidence of 3.48%. After excluding 54 cases, a total of 240 full-term asphyxiated babies were included as cases, and another 240 babies matched for birth weight and gestational age were included as controls (Flow Diagram 1).

In both the case and control groups, there was a predominance of rural patients since the hospital mainly serves tribal and rural populations. The male-to-female ratio was 1.3:1 and 1.09:1 among cases and controls, respectively. However, there were no significant statistical differences in the distribution of maternal age, parity, place of delivery, and mode of delivery between the two groups (Table 1).

In the study, BA cases had a higher prevalence of meconium-stained liquor and longer duration of resuscitation compared to controls, which is statistically significant ($p<0.0001$). Maternal hypertension, antepartum hemorrhage, and prolonged second stage of labor were significantly associated with BA ($p<0.05$). However, no significant statistical differences were found between cases and controls in terms of maternal age, parity, place of delivery, and mode of delivery (Table 1).

Table 1: Maternal and demographic data of both groups

Variables	Cases (240) (%)	Controls (240) (%)	p-value
Age of mother			
<20	17 (7.08)	19 (7.91)	0.81
20–35	216 (90)	212 (88.33)	
>35	7 (2.92)	9 (3.75)	
Residence of mother			
Urban	61 (25.42)	85 (35.42)	0.02
Rural	179 (74.58)	155 (64.58)	
Socio economic status			
Upper class	1 (0.42)	5 (2.09)	0.188
Middle class	55 (22.92)	47 (19.58)	
Lower class	184 (76.66)	188 (78.33)	
Parity			
Primipara	157 (62.42)	169 (70.42)	0.282
Multipara	83 (34.58)	71 (29.58)	
Antenatal care			
Regular (≥3 visits)	188 (78.33)	202 (84.17)	0.1284
Irregular (<3 visits)	52 (21.67)	38 (15.83)	
Place of delivery			
Tertiary hospital	155 (64.58)	169 (70.42)	0.098
Health center	77 (32.09)	69 (28.75)	
Home delivery	8 (3.33)	2 (0.83)	
Mode of delivery			
Vaginal	167 (69.58)	182 (75.83)	0.15
Caesarian section	73 (30.42)	58 (24.17)	
Duration of labor			
Normal	145 (60.42)	210 (87.5)	<0.0001
Prolonged	95 (39.58)	30 (12.5)	
Maternal risk factors			
Prolonged 2nd stage of labor	95 (39.58)	30 (12.5)	<0.0001
Hypertension	100 (41.67)	61 (25.42)	0.00023
Malpresentation	15 (6.25)	9 (3.75)	0.295
Antepartum hemorrhage	35 (14.58)	8 (3.33)	<0.0001
Fever	10 (4.17)	15 (6.25)	0.41
Sex of neonates			
Male	131 (54.58)	126 (52.5)	0.71
Female	109 (45.42)	114 (47.5)	
Age of neonate at admission			
0–1 h	148 (61.67)	10 (4.17)	<0.0001
1–6 h	86 (35.83)	23 (9.58)	
>6 h	6 (2.5)	117 (48.75)	
Amniotic fluid			
Meconium stained	88 (36.67)	20 (8.33)	<0.0001
Clear	152 (63.33)	220 (91.67)	

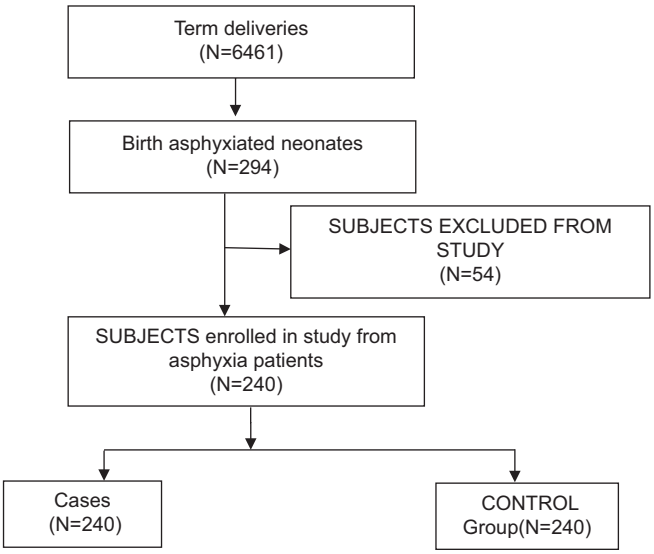
The study observed various neonatal complications in the case group, which included hypoxic-ischemic encephalopathy (HIE) in 61.25% of cases, convulsions in 30.83%, apnea in 5%, septicemia in 16.25%, respiratory distress in 26.66%, and cardiac arrest in 10.83% of patients. Among these complications, HIE, convulsions, and apnea were significantly more common in the BA cases than in the control group ($p<0.05$), as indicated in Table 2.

It was found that the case group had a significantly longer average hospital stay (4.529 days) than the control group (2.804 days). Furthermore, 10.42% of asphyxiated infants developed neurological complications, while no such complications were reported in the control group. The case group also had a higher mortality rate, with 26 deaths (10.83%) compared to only 4 deaths (1.67%) in the control group, a statistically significant difference. These results suggest that BA is associated with prolonged hospitalization, an increased risk of neurological complications, and a higher mortality rate (Table 3).

The Sarnat and Sarnat staging of HIE was used to classify the patients, revealing that 38.75% had no HIE, 32.92% had HIE-I, 22.92% had HIE-II, and 5.42% had HIE-III. The NO HIE and HIE-I categories had a discharge rate of 100%, while HIE-II had a discharge rate of 76.36% and HIE-III had a discharge rate of 0%. In addition, the death rate was 0% in NO HIE and HIE-I patients, while it was 24.64% and 100% in HIE-II and HIE-III, respectively. The difference in discharge rate and death rate among asphyxiated patients was statistically significant ($p<0.05$) (Table 4).

The correlation between the duration of resuscitation and grade of HIE in asphyxiated babies was found significant ($p<0.05$). Severe HIE was observed in cases where resuscitation lasted for more than 2 min (Table 5).

Table 6 shows that the duration of resuscitation was longer for patients who were delivered at a primary health center or home compared to those who were delivered at a tertiary care hospital ($p<0.05$). The table displays the frequency and percentage of the duration of resuscitation for each delivery location category. Among the patients who received resuscitation for more than 2 min, the majority were delivered at a primary health center. This finding suggests that the place of delivery may influence the need for resuscitation and highlights the importance of adequate neonatal care at all levels of healthcare.



Flow Diagram 1: Enrolment details

Table 2: Complications in cases versus controls

Variable	Cases (%)	Controls (%)	p-value
HIE	147 (61.25)	0	-
Convulsions	74 (30.83)	13 (5.42)	<0.0001
Apnea	12 (5)	3 (1.25)	0.035
Septicemia	39 (16.25)	10 (4.17)	<0.0001
Respiratory distress	64 (26.66)	31 (12.92)	0.002
Cardiac arrest	26 (10.83)	4 (1.67)	<0.0001

HIE: Hypoxic-ischemic encephalopathy

Table 3: Outcome of cases versus controls

Outcomes	Cases (%)	Controls (%)	p-value
Average hospital stay	4.529	2.804	<0.0001
Discharge without apparent sequelae	189 (78.75)	236 (98.33)	<0.0001
Discharge with neurological sequelae	25 (10.42)	0 (0%)	<0.0001
Death	26 (10.83)	4 (1.67)	<0.0001

DISCUSSION

Our study found that the male-to-female ratio was 1.3:1 among BA patients. Our results indicate that maternal risk factors such as hypertension (41.67%), antepartum hemorrhage (14.58%), and prolonged 2nd stage of labor (39.58%) had a significant association with BA. Similar findings were observed in previous studies conducted by Dongol *et al.* [9] and Bashir *et al.* [10] Furthermore, a single-centered study by Wosenu *et al.* [11] in Ethiopia reported fetal distress, cesarean delivery, meconium-stained fluid, and prolonged labor as risk factors for BA [11-13].

Studies in various countries have reported a significant association between preeclampsia and BA, and the present study also found that neonates born to mothers with preeclampsia were at a higher risk of developing BA. This finding is consistent with studies conducted in Nairobi by Kibai [14], Nigeria by Aliyu *et al.* [15], and Pakistan by

Table 4: Grading of HIE versus outcome

Grade	Outcome		
	Average hospital stay	Discharge	Death
NO HIE	2.16D	93 (38.75%)	0(%)
HIE-I	3.48 D	79 (32.92%)	0(%)
HIE-II	8.47 D	42 (17.5%)	13 (5.42%)
HIE-III	11.15 D	0 (0%)	13 (5.42%)
Total	-	214 (89.17%)	26 (10.83%)
p-value	<0.0001	<0.0001	

HIE: Hypoxic-ischemic encephalopathy

Table 5: Duration of resuscitation versus grade of HIE

Duration of resuscitation	No HIE (%)	HIE-I (%)	HIE-II (%)	HIE-III (%)
<1	59 (24.58)	32 (13.33)	12 (5)	0 (0)
1–2	14 (5.83)	44 (18.33)	26 (10.83)	3 (1.25)
>2	20 (8.33)	3 (1.25)	17 (7.08)	10 (4.17)
p-value	<0.0001			

HIE: Hypoxic-ischemic encephalopathy

Table 6: Duration of resuscitation versus place of delivery in BA patients

Duration of resuscitation	Tertiary hospital delivery	Health center delivery	Home delivery
<1	83 (34.58)	20 (8.33)	0 (0%)
1–2	59 (24.58)	28 (11.67)	0 (0%)
>2	13 (5.42)	29 (12.08)	8 (3.33)
p-value	<0.0001		

Tabassum *et al.* [16]. The possible reason for this association could be the reduced blood flow to the fetus resulting in hypoxia and eventually leading to BA.

The mortality rate in Birth asphyxiated babies was found to be 10.8% in our study. Interestingly, this rate is lower than that reported in several other studies, such as Uchenna *et al.* [17] (18%), Ilah *et al.* [18] (25.5%), Egharevba *et al.* [19] (30%), Lee *et al.* [20] (30%), and Sepeku and Kohi [21] (62.5%). However, our findings are in line with a study conducted by Idris [22] in Nigeria, which also reported a mortality rate of 10.3% in asphyxiated babies. The lower mortality rate in our study could possibly be attributed to early resuscitation and timely referral to a tertiary care hospital.

The study found that meconium-stained liquor was more common in cases of BA, and babies with meconium aspiration were at a higher risk of developing BA. The duration of resuscitation was also longer in these babies compared to the control group. Similar findings were reported in a case-control study by Hayes *et al.* [23], which showed a significant association between higher-grade meconium and BA in newborn infants. The release of meconium in the intrauterine environment can lead to respiratory complications at Birth, which increases the risk of profound hypoxia and BA.

In the present study in cases of asphyxia, complications were observed in a substantial number of patients, including HIE (61.25%), convulsions (30.83%), apnea (5%), septicemia (16.25%), respiratory distress (26.66%), and cardiac arrest (10.83%). These findings are consistent with those of other studies, such as a study by Babu *et al.*, which reported that the most common complications observed in BA patients were HIE (45.1%), convulsions (32.9%), and apnea (14.3%). A similar association was also observed by Dongol *et al.* and Bashir *et al.* In addition, 25 (10.42%) babies out of all the asphyxiated babies in our study developed sequelae.

In this study, the incidence of HIE in BA patients was 61.25%. As per Sarnat and Sarnat's staging, 93 (38.75%) patients had no HIE. The mortality rate was found to be 0% in patients with no HIE and HIE-I patients, while it was 24.64% and 100% in HIE-II and HIE-III, respectively. These findings are similar to the study by Gebregziabher *et al.* [24], which reported that most cases with stage III HIE (84.6%) died. However, in other studies such as Ekwochi *et al.* [17] from southeast Nigeria and Pattar *et al.* [25] from Karnataka, India, mortality rates were reported to be 66.7% and 44.4%, respectively. In the study by Babu *et al.* [11], the overall mortality rate was found to be 17.8%. The mortality rate was significantly higher in patients with Stage III HIE (50%) as compared to those with Stage I (4.1%) and Stage II (21.7%) HIE.

In the study by Babu *et al.*, 42% of cases recovered without sequelae and 26% had neurological sequelae. Recovery rates were higher in Stage S-I (91.8%) and II (60.9%) compared to Stage III (22.2%) as reported by other authors 2 [10,26,27].

In our study, a total of 25 (10.42%) babies out of all asphyxiated babies developed sequelae. The overall discharge rate was 100% in the NO HIE and HIE-I categories. However, it was 76.36% in HIE-II and 0% in HIE-III patients.

The duration of resuscitation is the time taken to initiate and complete the resuscitative measures in a newborn with BA. In this statement, it is suggested that a longer duration of resuscitation, specifically more than 2 min, is associated with a more severe form of HIE in asphyxiated babies. This finding suggests that early and prompt resuscitation may be crucial in preventing severe HIE in asphyxiated babies. The duration of resuscitation is longer in babies delivered in primary health centers or at home compared to those delivered in a tertiary care hospital. This finding could be due to the availability of advanced resuscitative measures and trained healthcare personnel in tertiary care hospitals. The reference to a review by Moshiro *et al.* [28] further supports this finding.

CONCLUSIONS

The study found that perinatal asphyxia had a high prevalence and mortality rate, with prolonged labor, meconium-stained amniotic fluid, and preeclampsia as significant predictors. HIE was the most common serious neonatal complication, and longer resuscitation duration was associated with severe HIE. Effective post-delivery resuscitation, health worker training, and necessary equipment can reduce BA and its complications in resource-limited peripheral systems. Specialized care for infants with BA in public hospitals may decrease associated mortality risk.

AUTHORS' CONTRIBUTIONS

The manuscript was written by Pushparaj patil and the data collection and analysis were done by Pushparaj Patil. Research reviewed and edited by Zubair Khan and statistical analysis done by Zubair Khan. Manuscript finalized, edited, and submitted for publication by Pushparaj Patil.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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