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Maternal and Perinatal Risk Factors Associated with Hypoxic Ischemic Encephalopathy in Term Neonates: A Prospective Cohort Study from North India

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Abstract:
Background: Hypoxic ischemic encephalopathy (HIE) following perinatal asphyxia is a major cause of neonatal morbidity and mortality in low-resource settings, including India[1,2].
Objective: To determine maternal and perinatal risk factors associated with HIE in term neonates with perinatal asphyxia.
Methods: This prospective observational study was conducted at G.B. Pant Hospital, Srinagar, from November 2017 to April 2019. Term neonates (□37 weeks, >1.8 kg) with Apgar <6 at 5 min and features of HIE were included[3]. Maternal, intrapartum, and neonatal variables were recorded. Associations between these factors and HIE severity (Sarnat stages I–III) were assessed using chi-square/Fisher's exact test.
Results: Of 217 neonates, 171 (78.8%) had HIE. Significant predictors of higher HIE grade included unbooked pregnancies, primigravidity, prolonged labor, meconium-stained liquor, delayed hospital arrival (>5 h), low Apgar scores, and need for advanced resuscitation.
Conclusion: Preventable factors contribute significantly to severe HIE. Strengthening antenatal care, intrapartum monitoring, and neonatal resuscitation can reduce the burden[4-6].

INTRODUCTION

Hypoxic ischemic encephalopathy (HIE) is a serious neurological condition resulting from impaired cerebral blood flow and oxygen delivery to the brain during the perinatal period. Globally, perinatal asphyxia accounts for approximately 23% of neonatal deaths, with an estimated 1 million survivors developing long-term neurodevelopmental impairment each year[1]. In India, the burden of HIE is higher due to limited access to quality antenatal care, gaps in intrapartum monitoring, and delays in referral and advanced neonatal care[2]. The severity of HIE depends on multiple factors including antenatal health, intrapartum events, and the timeliness and adequacy of resuscitation[3]. Several studies have identified predictors of poor neurological outcomes, but region-specific data are essential to tailor prevention strategies[4-6]. The present study was designed to prospectively evaluate maternal and perinatal risk factors for HIE in term neonates in North India, with the aim of identifying modifiable factors for targeted interventions.

METHODS

This was a prospective observational study conducted at the Department of Pediatrics & Neonatology, G.B. Pant Hospital, Srinagar, from November 2017 to April 2019. Term neonates (□37 weeks) weighing

>1.8 kg, with Apgar <6 at 5 minutes and exhibiting clinical features of HIE as per Sarnat and Sarnat staging[3], were included. Exclusion criteria were preterm birth, major congenital malformations, chromosomal anomalies, or conditions incompatible with life. Maternal and perinatal variables recorded included maternal age, booking status, parity, obstetric complications, mode of delivery, time to reach hospital, birth weight, Apgar score at 5 minutes, and resuscitation methods used. Data were analyzed using SPSS v20.0. Categorical variables were compared using chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Mode of Delivery vs HIE Severity

Mode of Delivery	Grade I	Grade II	Grade III	p-value
Normal Vaginal	74%	70.2%	63%	<0.001
Instrumental	4%	11.7%	14.8%	
Emergency LSCS	22%	18.1%	11.1%	
Elective LSCS	-	-	-	

Table 2: Booking Status vs HIE Severity

Booking Status	Grade I	Grade II	Grade III	p-value
Booked	56%	40%	25.9%	0.02
Unbooked	44%	60%	74.1%	

Table 3: Parity vs HIE Severity

Parity	Grade I	Grade II	Grade III	p-value
Primigravida	50%	58.5%	74.1%	0.017
Multigravida	50%	41.5%	25.9%	

Table 4: Time to Reach Hospital vs HIE Severity

Time to Hospital	Grade I	Grade II	Grade III	p-value
<1 hour	42.9%	38%	18.5%	<0.01
1–5 hours	35%	40%	44.4%	
>5 hours	22.1%	22%	37.1%	

Table 5: Apgar Score at 5 Minutes vs HIE Severity

Apgar Score	Grade I	Grade II	Grade III	p-value
3	2%	6%	12.4%	<0.001
4	15%	36.9%	41%	
5	83%	57.1%	46.6%	

Table 6: Resuscitation Method vs HIE Severity

Method	Grade I	Grade II	Grade III	p-value
Tactile only	55%	24%	5%	<0.001
Bag-mask ventilation	40%	36.9%	28%	
Intubation	5%	39.1%	67%	

DISCUSSION

This study highlights several modifiable maternal and perinatal factors significantly associated with the severity of HIE. Our findings that unbooked status, primigravidity, prolonged labor, and meconium-stained liquor increase the risk of severe HIE align with previous studies by Padyachee and Ballot[5] and Ilah et al.[11]. The association between delayed hospital arrival and higher HIE grades reinforces the need for effective referral systems and community awareness[7,8]. Low Apgar scores and the need for advanced resuscitation were strong predictors, consistent with global evidence that rapid, skilled neonatal resuscitation reduces mortality and morbidity[6,9]. The results underscore the importance of strengthening antenatal care coverage, promoting institutional deliveries, and ensuring continuous intrapartum monitoring. Policy measures targeting these factors could have a significant impact on neonatal survival and long-term neurological outcomes in similar settings[10].

CONCLUSION

HIE severity in term neonates is significantly influenced by preventable maternal and perinatal factors. Public health interventions focusing on antenatal coverage, timely obstetric care, skilled birth attendance, and immediate neonatal resuscitation can reduce the burden of severe HIE in resource-limited settings.

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