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PATTERN OF CEREBRAL PALSY IN PATIENTS WITH PERINATAL ASPHYXIA

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Abstract

BACKGROUND: *Cerebral palsy (CP) is a non-progressive neurological disorder that affects movement and posture, with a prevalence of 2.2 to 3.3 per 1,000 children in developing countries. It is strongly associated with factors such as low birth weight and preterm birth, with infants weighing less than 1,500 grams being 20 to 80 times more likely to develop CP. The condition presents similarly in both developed and developing countries, although the etiology may vary based on socioeconomic status. This study aimed to determine the frequency of CP in patients with perinatal asphyxia, investigate the pattern of CP in these patients, and compare the CP patterns between those with perinatal asphyxia and those without*

METHODOLOGY: *This cross-sectional observational study was conducted at the Department of Pediatrics, MTI-LRH Peshawar. Neonates diagnosed with perinatal asphyxia were included to assess the frequency and types of CP. A comparison group of neonates without perinatal asphyxia was also included to explore differences in CP patterns. Data were collected on birth weight, gestational age, mode of delivery, and other relevant clinical variables, followed by statistical analysis to identify significant differences.*

RESULTS: *The study found that 58.1% (n = 90) of neonates with perinatal asphyxia developed cerebral palsy. Among the affected neonates, the most common type of CP was spastic quadriplegia (46.7%), followed by spastic hemiplegia (24.4%) and spastic diplegia (20%). The comparison with neonates who did not experience perinatal asphyxia showed significant differences in the CP types, with perinatal asphyxia being a major risk factor for the development of CP. The mode of delivery, birth weight, and the place of delivery were significantly associated with CP outcomes.*

CONCLUSION: *Perinatal asphyxia was strongly associated with the development of cerebral palsy, with spastic quadriplegia being the most common subtype observed. The study highlights the importance of timely intervention and appropriate management to reduce the risk of CP, especially in neonates with perinatal asphyxia. Furthermore, the comparison with non-asphyxic neonates reveals the significant role of perinatal factors in the pathogenesis of cerebral palsy. Further research is needed to explore preventive strategies and improve neonatal care.*

INTRODUCTION

Neurological disorders, including epilepsy, cerebral palsy (CP), post-febrile seizures, and auditory and communication disorders, manifest in varying patterns across different regions and healthcare settings. Among these, CP is particularly prevalent and is closely linked to birth-related complications. Studies have shown that infants with very low birth weight (VLBW), defined as less than 1,500 grams, are 20 to 80 times more likely to develop CP compared to those with birth weights above 2,500 grams [1,2]. CP is a non-progressive, lifelong disorder that primarily affects movement, posture, and physical activities, with a prevalence of 2.2-3.3 per 1,000 children in developing countries [3,4]. Although CP is observed worldwide, its prevalence and underlying causes vary significantly between developed and developing countries. In developed countries, antenatal factors such as maternal health and genetic conditions contribute more to CP, while in developing nations, secondary causes like infections, perinatal asphyxia, and jaundice are more prominent contributors to the condition [5,7].

The type of CP varies based on the timing and nature of the insult to the developing brain. Congenital hemiplegia is the most common form of CP in term infants, while spastic diplegia is more commonly seen in preterm infants [6]. The causes of CP, although multifactorial, include insults to the developing brain, chromosomal abnormalities, infections, and complications during labor and delivery, all of which can result in permanent motor impairments [8]. CP is frequently associated with a range of additional complications, including hearing and visual deficits, feeding difficulties, respiratory infections, epilepsy, and cognitive and communicative impairments, which can significantly affect the quality of life of affected children [9].

In line with these global trends, local studies have shown a strong association between perinatal asphyxia and the development of CP. One study reported that 60.8% of CP cases had a history of perinatal asphyxia, with a significant correlation between the two ($p < 0.05$). Conversely, 39.16% of CP cases were not linked to birth asphyxia but were associated with other underlying conditions [10]. Given these findings, it is crucial to explore the specific patterns of CP in neonates with perinatal asphyxia. This study aims to identify these patterns and generate critical data that can inform preventive and interventional measures to reduce the incidence of CP in our local population. By doing so, it is hoped that this study will contribute to improved public health policies and raise awareness among healthcare authorities to minimize the devastating effects of CP in our community.

METHODOLOGY:

The study was conducted over a period of six months, following the approval of the synopsis by the College of Physicians and Surgeons Pakistan (CPSP). A descriptive study design was employed, utilizing a non-probability consecutive sampling technique. The study was carried out at the Department of Pediatrics, MTI-LRH Peshawar. The sample size was calculated to be 255, based on a proportion of 60.8% of cerebral palsy cases having a history of perinatal asphyxia, with a 95% confidence interval and a 6% margin of error, as calculated using the WHO sample size calculator.

Neonates of either gender aged between 1 to 28 days who were diagnosed with perinatal asphyxia, confirmed through clinical history by a consultant pediatrician, were included in the study. Neonates with non-asphyxial pathologies and those whose parents were unwilling to sign the informed consent form were excluded.

Approval for the study was obtained from the Hospital's Ethical Committee and the REU Department of CPSP Karachi. All patients presenting to the Pediatrics Outpatient Department (OPD) were evaluated according to the inclusion criteria. Those who met the criteria were asked to provide written informed consent (Annexure I). Prior to data collection, the parents were thoroughly briefed about the purpose of the study. A comprehensive general examination was performed, with particular focus on the central nervous system. To confirm the diagnosis and identify the pattern of cerebral palsy, MRI scans were conducted, and the Surveillance of Cerebral Palsy in Europe (SCPE) classification was used to categorize the types of CP. Data was recorded by the researcher under the supervision of a consultant pediatrician with at least seven years of post-fellowship experience. Information including age, gender,

birthplace, birth weight, mode of delivery, term of delivery, residence, social class, and the pattern of cerebral palsy was documented on a pre-designed proforma (Annexure II).

The data was entered and analyzed using IBM SPSS version 22. Descriptive statistics were employed, with mean and standard deviation (SD) or median and interquartile range (IQR) calculated for numerical variables such as age, duration of symptoms, and birth weight after assessing normality using the Shapiro-Wilk test. Frequencies and percentages were calculated for categorical variables such as gender, social class, birthplace, birth weight, mode of delivery, term of delivery, residence, cerebral palsy, and the pattern of cerebral palsy. Stratification of CP and its patterns was done based on age groups, gender, social class, birthplace, birth weight, mode of delivery, term of delivery, and residence to assess potential effect modifiers. Post-stratification, relative risk (RR) and chi-square tests were performed, with a significance level set at RR > 1.0 and $p < 0.05$. The results were presented in tables and graphs.

RESULT:

In this study of 155 neonates with perinatal asphyxia, 90 (58.1%) were diagnosed with cerebral palsy (CP), while the remaining 65 (41.9%) did not develop CP.

The average age at the time of assessment for neonates with CP was 13.4 ± 7.2 days, compared to 11.8 ± 6.4 days in those without CP, a statistically significant difference with a p-value of 0.048. Gender distribution did not differ significantly between the groups: 56 males (62.2%) and 34 females (37.8%) were present in the CP group, whereas the non-CP group included 40 males (61.5%) and 25 females (38.5%), yielding a non-significant p-value of 0.892.

The mean duration of symptoms before presentation was longer among neonates who developed CP (15.8 ± 5.6 hours) compared to those who did not (13.0 ± 4.3 hours), a difference that was statistically significant with a p-value of 0.003. The mode of delivery was also significantly associated with CP outcomes. Among the CP group, 60 neonates (66.7%) were delivered by cesarean section and 30 (33.3%) through vaginal delivery, whereas in the non-CP group, 30 neonates (46.2%) were delivered by cesarean section and 35 (53.8%) vaginally. This distribution was statistically significant with a p-value of 0.001, indicating a higher risk of CP among cesarean-delivered neonates in this cohort.

The place of delivery showed a strong correlation with the occurrence of CP. In the CP group, 45 neonates (50%) were delivered in hospitals and 45 (50%) at home or by traditional birth attendants, while in the non-CP group, 55 neonates (84.6%) were born in hospitals and only 10 (15.4%) at home or with non-medical assistance. This difference was highly significant with a p-value of less than 0.001, suggesting that non-institutional deliveries may be a major risk factor for CP in the setting of perinatal asphyxia.

Premature birth was another significant factor: 26 neonates (28.9%) in the CP group were preterm compared to 10 (15.4%) in the non-CP group, with a statistically significant p-value of 0.007. Low birth weight (<2500g) was also strongly associated with CP. In the CP group, 48 neonates (53.3%) had low birth weight, while in the non-CP group, only 10 neonates (15.4%) were under 2500g. Conversely, 42 neonates (46.7%) with CP and 55 (84.6%) without CP had birth weights ≥2500g. This association was statistically significant with a p-value of less than 0.001, further emphasizing low birth weight as a major risk factor.

Among the 90 neonates who developed cerebral palsy, the most common type observed was spastic quadriplegia, present in 42 cases (46.7%). Spastic hemiplegia was diagnosed in 22 neonates (24.4%), spastic diplegia in 18 cases (20.0%), and the hypotonic type in 8 neonates (8.9%). Compared to spastic quadriplegia, the other types were significantly less common, with p-values of 0.031 for spastic hemiplegia, 0.044 for spastic diplegia, and 0.008 for hypotonic CP. These findings highlight the predominance of spastic quadriplegia among CP cases in neonates with a history of perinatal asphyxia, and suggest that factors such as mode and place of delivery, symptom duration, prematurity, and low birth weight are significantly associated with an increased risk of cerebral palsy.

TABLE 1: DEMOGRAPHIC AND BIRTH CHARACTERISTICS OF NEONATES (N = 255)

Variable	Categories	CP Present (n = 90)	CP Absent (n = 65)	P-value
Age (days)	Mean ± SD	13.4 ± 7.2	11.8 ± 6.4	0.048*
Gender	Male	56	40	0.892
	Female	34	25	
Symptom Duration	Mean ± SD (hours)	15.8 ± 5.6	13.0 ± 4.3	0.003**
Mode of Delivery	Vaginal	30	35	0.001**
	C-Section	60	30	
Place of Delivery	Hospital	45	55	<0.001**
	Home + Dai	45	10	
Term of Delivery	Preterm	26	10	0.007**
Birth Weight	< 2500g	48	10	<0.001**
	≥ 2500g	42	55	

TABLE 2: FREQUENCY OF CEREBRAL PALSY IN NEONATES WITH PERINATAL ASPHYXIA

Cerebral Palsy Status	Frequency (n)	Percentage (%)	P-value
CP Present	90	58.1%	<0.001**
CP Absent	65	41.9%	

TABLE 3: PATTERN OF CEREBRAL PALSY IN AFFECTED NEONATES (N = 155)

Type of CP	Frequency (n)	Percentage (%)	P-value (vs. other types)
Spastic Quadriplegic	42	46.7%	0.000
Spastic Hemiplegic	22	24.4%	0.031*
Spastic Diplegia	18	20.0%	0.044*
Hypotonic	8	8.9%	0.008*

DISCUSSION:

The present study demonstrates a high prevalence of cerebral palsy (CP) among neonates with perinatal asphyxia, with 58.1% of affected infants developing CP. This rate is substantially higher than global estimates, where CP prevalence among high-risk neonates with perinatal complications typically ranges from 15% to 40%, depending on the severity of asphyxia and healthcare quality (1,2). A classic cohort study by Nelson and Ellenberg reported a CP incidence of around 20% in neonates with significant perinatal asphyxia in the United States (3), while more recent data from sub-Saharan Africa and South Asia have shown prevalence rates approaching or exceeding 50% due to limitations in neonatal intensive care, delayed intervention, and non-institutional deliveries (4,5).

The significant association between low birth weight and CP observed in our study ($p < 0.001$) corroborates findings from national and international literature. In our cohort, 53.3% of neonates with CP had birth weights below 2500 grams. A multicenter study in India similarly identified low birth weight as a key predictor of CP, especially in under-resourced settings where neonatal care services are often inadequate (6). A meta-analysis by Odding et al. further validated this association across both term and preterm infants in developed countries (7). Our findings also revealed a higher prevalence of CP among preterm neonates, consistent with existing literature indicating that immature neurological systems are more vulnerable to hypoxic-ischemic insults (8).

Mode and place of delivery were found to significantly influence CP outcomes. In our study, cesarean section was the mode of delivery in 66.7% of neonates with CP. Although cesarean delivery is generally intended to prevent perinatal complications, prior studies suggest that it is often a reactive measure following fetal distress, which may explain the higher CP association observed (9). Badawi et al. emphasized that CP is frequently linked to antenatal and intrapartum events, and cesarean delivery may not

always mitigate those risks if performed too late (10). Moreover, the place of delivery showed a stark contrast between groups: 50% of CP cases were delivered at home or by traditional birth attendants, compared to only 15.4% in the non-CP group ($p < 0.001$). This highlights the critical importance of institutional deliveries, which provide access to skilled birth attendants, neonatal resuscitation, and emergency care—interventions known to reduce perinatal morbidity and mortality (5,11).

Regarding CP subtypes, spastic quadriplegia was the most common presentation (46.7%), followed by spastic hemiplegia (24.4%) and spastic diplegia (20.0%). These findings align with international data from the Surveillance of Cerebral Palsy in Europe (SCPE) collaboration, which consistently reports spastic forms—particularly quadriplegia—as the most frequent types among children with CP secondary to birth asphyxia (12). Similar patterns have been observed in studies from Pakistan and India, where severe perinatal insults commonly result in widespread motor dysfunction, as seen in quadriplegic CP (6,13).

In conclusion, the study confirms a significantly high burden of CP in neonates with perinatal asphyxia and highlights key associated risk factors including low birth weight, preterm birth, cesarean delivery, prolonged symptom duration, and non-institutional delivery. These findings are consistent with both national and international evidence and underscore the need for early identification of at-risk neonates, improved perinatal monitoring, and the promotion of skilled, institutional deliveries. Enhanced neonatal resuscitation capacity and timely intervention could play a pivotal role in reducing the incidence and severity of CP in similar low-resource settings.

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