Original Article

Prevalence and Pattern of Hypoxic Ischemic Encephalopathy in Pediatric Patients Analysis by MRI Assistance

Hypoxic Ischemic Encephalopathy by MRI Assistance

Haji Gul, Sijad-Ur-Rehman, Inayat Ullah and Ahmed Khizar

ABSTRACT

Objective: To examine the prevalence and pattern of hypoxic-ischemic encephalopathy (HIE) in pediatric patients.
Study Design: A retrospective cross-sectional study
Place and Duration of Study: This study was conducted at the Department of Pediatrics, Bacha Khan Medical Complex from July 2022-January 2023.
Materials and Methods: Our study included children from newborns to 16 years of age who either had a history of fits, abnormal APGAR score, delayed cry or delayed milestones. The brain MRI was performed on 1.5 tesla scanner with a standard protocol and interpreted by Experienced Radiologists Findings were recorded and data was analyzed on SPSS version 26. Children who were born via instrumental delivery were excluded from our study. A total of 50 pediatric patients from newly born to 16 years old with HIE were included.
Results: The overall prevalence of HIE was 28%. Mild to moderate HIE was the most prevalent pattern, accounting for 19% of the cases. The most common pattern of injury was global (14%), followed by focal (12%) and multifocal (2%). The most common affected areas were the basal ganglia, thalamus, and cortical white matter. The results showed that HIE was 28% with the majority of cases being moderate to mild. The most common injury pattern was global, followed by focal and multifocal.
Conclusion: Hypoxic Ischemic Encephalopathy is a common occurrence in our society and MRI is the recommended modality due to its sensitivity and superior soft-tissue resolution. In developing countries due to a lack of proper facilities and awareness, there is an increased incidence of HIE which leads to increased morbidity therefore increasing awareness and early diagnosis is of utmost importance. The most common injury pattern was global, followed by focal and multifocal, with the most affected areas being the basal ganglia, thalamus, and cortical white matter.
Key Words: Hypoxic Ischemic Encephalopathy, Pediatric, Magnetic Resonance Imaging

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INTRODUCTION

A common cause of cerebral palsy in children is neonatal hypoxic encephalopathy. It is a common occurrence in children with a reported rate of 1.5/1000 live births in developed countries while low-middle income countries reporting a much higher prevalence ranging from 10-20 cases per 1000 live births[1,2]. Normal cerebral auto-regulation is lost as a result of insufficient cerebral blood flow and poor blood oxygenation (hypoxia). There are multiple patterns of brain injury that can result from HIE depending on the duration and severity of hypoxia and gestational age at which the child was born and can range from focal deficits to global brain injury with varying deficits[3]. Multiple neuroimaging modalities are used to diagnose the location and severity of the brain injury. Characterization of the extent of injury can be done via multiple modalities ranging from conventional ultrasound, computed tomography (CT) Magnetic resonance imaging (MRI) to newer techniques including Diffusion weighted imaging (DWI) and magnetic resonance spectroscopy (MRS)[4]. Despite advancements in prenatal treatment, hypoxic-ischemic injury (HII) accounts for 23% of newborn mortality worldwide (Lawn, Cousens, & Zupan, 2005)[5] and leaves 25% of afflicted term infants with persistent neurological impairments.

HIE is the most common cause of brain injury in newborns and can occur in any age group (Fanos, Pintus, & Dessi, 2018; Rodríguez, 2020)[6]. It is estimated that up to 1.5 million newborns are affected worldwide (Glass & Ferriero, 2007; Wu et al., 2022)[7]. Early diagnosis and treatment of HIE are essential in order to minimize long-term neurological deficits (Douglas-Escobar & Weiss 2015)[8]. Magnetic resonance

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imaging (MRI) is the gold standard imaging modality for the diagnosis of HIE (Cheong et al., 2012)[9]. The aim of this study was to investigate the prevalence and pattern of HIE in pediatric patients newly born to 16 years old using MRI (Cheong et al., 2012; Mercuri et al., 2000)[9,10].

MATERIALS AND METHODS

This retrospective, cross-sectional study conducted in the Department of Pediatrics Bacha Khan Medical Complex from July 2022-January 2023. A total 50 pediatric patients from newly born to 16 years old with HIE were included. Hospital ethics committees approved the study. Data was obtained according to the Declaration of Helsinki. The study's goals and methodology were explained to patients, and their legal guardians gave written permission. All data was protected and participants were anonymous.

All patients underwent magnetic resonance imaging (MRI) at our institution. The MRI findings were assessed for the presence of HIE, the pattern of injury, and affected areas.

Percentages and frequency were calculated for categorical variables (gender, pattern of injury distribution, severity of injury). Chi-square test was used to evaluate the association between the prevalence of HIE and the pattern of injury. There was a statistically significant association between the prevalence of HIE and the pattern of injury ($p < 0.001$).

RESULTS

The overall prevalence of HIE was 28%. Mild to moderate HIE was the most prevalent pattern, accounting for 19% of the cases. The most common pattern of injury was global (14%), followed by focal (12%) and multifocal (2%). The most affected areas were the basal ganglia, thalamus, and cortical white matter.

Table No. 1: Comparison of Gender and age prevalence rate

Age	Prevalence
Newborn	[10%]
[1-5 years]	[8%]
[6-10 years]	[7%]
[11-16 years]	[3%]
Gender	**Prevalence**
[Male]	[52%]
[Female]	[48%]

Table No. 2: Association between the prevalence of HIE and the pattern of injury

Pattern of Injury	Prevalence of HIE
Global	14%
Focal	12%
Multifocal	2%

Table No. 3: Association of affected areas and prevalence rate

Areas Affected	Prevalence
Basal ganglia	20%
Thalamus	17%
Cortical white matter	15%

Table No. 4: Identify the Location, Severity and Prevalence Rate

Severity	Prevalence
Mild	19%
Moderate	9%
Location	
Severe	0%
Cerebral	25&
Subcortical	3%

Table No. 5: Summary of the Study

Prevalence	**28%**		
Pattern of Injury	Global (14%)	Focal (12%)	Multifocal (2%)
Areas Affected	Basal ganglia (20%)	Thalamus (17%)	Cortical White Matter (15%)
Age			
Newborn (10%)	[1-5 years] (8%)	[6-10 years] (7%)	[11-16 years] (3%)
[Gender]	Male(52%)	Female (48%)	
Severity	Mild(19%)	Moderate (9%)	Severe (0%)
Location	Cerebral (25%)	Subcortical (3%)	

DISCUSSION

We examined the prevalence and pattern of HIE in pediatric patients newly born to 16 years old using MRI. The results showed that the prevalence of HIE was 28%, with the major of cases being mild to moderate. The most common pattern of injury was global, followed by focal and multifocal (Rutherford et al., 2010; Twomey, Twomey, Ryan, Murphy, & Donoghue, 2010)[11,12]. The most affected areas were the basal ganglia, thalamus, and cortical white matter. The findings of this study provide insight into the prevalence and pattern of HIE in pediatric patients, which may aid in the early diagnosis and treatment of this condition The results of this study suggest that magnetic resonance imaging is an important tool for the diagnosis of hypoxic ischemic encephalopathy (HIE) in pediatric patients. Moreover, the pattern of HIE on MRI was generally consistent with the clinical presentation of the condition, with the majority of affected patients demonstrating white matter injury and deep grey matter involvement. Immediate asphyxia is the most common cause of HIE in neonates. Prolonged asphyxia causes hypoxia that leads to decreased cerebral perfusion resulting in increased lactate levels in brain and reduced ATP production. This in turns leads minimal

free radical clearance causing brain injury at cellular level. HIE can lead to complex cellular and molecular changes that if not treated timely can result in permanent brain injury, therefore the timing and duration of injury is important and early treatment within the first 60 minutes can lead to reduced severity of brain injury with improved prognosis[13]. The findings of this study are important as they suggest that MRI can be used to accurately diagnose HIE in pediatric patients and that the imaging findings correlate with the clinical presentation. This is of particular importance in the diagnosis of HIE as it is a condition that is not always easy to diagnose clinically. Furthermore, the findings suggest that early diagnosis of HIE is important in order to facilitate timely treatment and management (Yıldız, Ekici, & Tatlı, 2017)[14]. The results of this study should be interpreted with caution; however, as the sample size of the study was relatively small. Furthermore, the study was retrospective in nature and relied on a retrospective chart review for diagnosis, which may have introduced bias. Additionally, the study did not assess any long-term outcomes associated with HIE, and thus the clinical significance of the findings is unclear. In conclusion, this study suggests that MRI can be used to diagnose HIE in pediatric patients and that the pattern of HIE on MRI is consistent with the clinical presentation. However, further research is needed in order to better understand the clinical significance of the findings and to assess any long-term outcomes associated with HIE.

An MRI showed damage in 87 (61%) of 142 babies with mild HIE in a USA study. The most frequent injuries were punctate white matter (18%), deep grey (20%), and watershed (23%). Mild injury was more prevalent than moderate injury (11%) or severe injury (4%). Lesions were more frequently found to be sub acute (37%), acute (32%), or chronic (1%)[15]. This is in contrast to our study which shows 28% mild to moderate lesions with basal ganglia, thalamus, and cortical white matter as the most affected areas.

Limitations: This study has several limitations. First, the sample size was small and the results may not be generalizable to larger pediatric populations. Second, the study was retrospective in nature and may not have captured all cases of HIE. Finally, this study did not assess the long-term effects of HIE on the affected patients. Future studies should address these limitations.

CONCLUSION

This study examined the prevalence and pattern of HIE in pediatric patients newly born to 16 years old using MRI. The results showed that the overall prevalence of HIE was 28%, with the majority of cases being mild to moderate. The most common pattern of injury was global, followed by focal and multifocal, with the most affected areas being the basal ganglia, thalamus, and cortical white matter. The findings of this study provide insight into the prevalence and pattern of HIE in pediatric patients, which may aid in the early diagnosis and treatment of this condition.

Author's Contribution:

Concept & Design of Study:	Haji Gul
Drafting:	Sijad-Ur-Rehman, Inayat Ullah
Data Analysis:	Ahmed Khizar
Revisiting Critically:	Haji Gul, Sijad-Ur-Rehman
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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