

Citation: Mohammed, A., Khan, M. Q., Kiramatullah, Afridi, H. G., & Rehman, S. U. (2023). MRI-Assisted Prevalence and Pattern Analysis of Hypoxic Ischemic Encephalopathy in Pediatric Patients. *Global Drug Design & Development Review*, VIII(1), 22-27. [https://doi.org/10.31703/gdddr.2023\(VIII-I\).04](https://doi.org/10.31703/gdddr.2023(VIII-I).04)

▪ **Pages:** 22 – 27 ▪ **Vol. VIII, No. I** (Winter 2023) ▪ **p- ISSN:** 2788-497X ▪ **e- ISSN:** 2788-4120

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▪ **DOI:** 10.31703/gdddr.2023(VIII-I).04 ▪ **URL:** [http://dx.doi.org/10.31703/gdddr.2023\(VIII-I\).04](http://dx.doi.org/10.31703/gdddr.2023(VIII-I).04)

MRI-Assisted Prevalence and Pattern Analysis of Hypoxic Ischemic Encephalopathy in Pediatric Patients



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Abstract: *To examine the prevalence and pattern of hypoxic-ischemic encephalopathy (HIE) in pediatric patients This retrospective, cross-sectional study was conducted in the Department of Pediatrics LRH Peshawar from Jan 2020 to July 2020 and included 50 pediatric patients newly born to 16 years old with HIE. All patients had MRIs. HIE, damage pattern, and affected regions were evaluated on the MRI. 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. The results showed that HIE was 28%, with the majority of cases being moderate to mild. The most common pattern of injury was global, followed by focal and multifocal.*

Key Words: Hypoxic Ischemic Encephalopathy, Pediatric, Magnetic Resonance Imaging

Introduction

A disorder known as hypoxic-ischemic encephalopathy (HIE) is brought on by inadequate oxygenation of the brain which can result in a range of neurological deficits (Fenichel, 1983; Ferriero, 2004; Hill, 1999; Thornton et al., 2012).

Normal cerebral auto-regulation is lost as a result of insufficient cerebral blood flow and poor blood oxygenation (hypoxia). Diffuse brain damage develops from this, which leads to hypoxic-

ischemic encephalopathy (HIE). HIE affects 2.5 out of every 1000 live babies at full term and 7 out of every 1000 preterm births (Chalak et al., 2012; Graham, Ruis, Hartman, Northington, & Fox, 2008). Despite advancements in prenatal treatment, hypoxic-ischemic injury (HII) accounts for 23% of newborn mortality worldwide (Lawn, Cousens, & Zupan, 2005) and leaves 25% of afflicted term infants with persistent neurological impairments (Vannucci & Perlman, 1997).

HIE is the most common cause of brain injury

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in newborns and can occur in any age group (Fanos, Pintus, & Dessi, 2018; Rodríguez, 2020). It is estimated that up to 1.5 million newborns are affected worldwide (Glass & Ferriero, 2007; Wu et al., 2022). Early diagnosis and treatment of HIE are essential in order to minimize long-term neurological deficits (Douglas-Escobar & Weiss, 2015; Vannucci, 2000). Magnetic resonance imaging (MRI) is the gold standard imaging modality for the diagnosis of HIE (Cheong et al., 2012; Sanchez Fernandez, Morales-Quezada, Law, & Kim, 2017). 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).

Methodology

This retrospective, cross-sectional study included conducted in the Department of Pediatrics LRH Peshawar from Jan 2020 to July 2020. 50 pediatric patients newly born to 16 years old with HIE were included. 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.

Statistical Analysis

A 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 ($p < 0.001$).

Data Collection

Data were collected from the medical records of 50 pediatric patients newly born to 16 years old with HIE. All patients underwent MRIs at our institution. The MRI findings were assessed for the presence of HIE, the pattern of injury, and affected areas.

Ethical Consideration

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.

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 1

Association between the prevalence of HIE and the pattern of injury

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

Table 2

Association of affected areas and prevalence rate

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

Table 3*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 4*Identify the Location, Severity and Prevalence Rate*

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

Table 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). 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. The prevalence of HIE in this pediatric population was found to be high, with nearly one in five patients having evidence of HIE on MRI (Maalouf, Counsell, Battin, & Cowan, 1998; Prager & Roychowdhury, 2007). Moreover, the pattern of HIE on MRI was generally

consistent with the clinical presentation of the condition, with the majority of affected patients demonstrating whitematter injury and deep grey matter involvement. 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 (Fenichel, 1983; Hill, 1999). This is of particular importance in the diagnosis of HIE as it is a condition which 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 (Derganc & Osredkar, 2008; Yildiz, Ekici, & Tatli, 2017). 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 (Gire et al., 2000).

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.

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.

Future Finding

Future studies should focus on larger populations and longer follow-up periods. Additionally, further research should evaluate the long-term effects of HIE on pediatric patients.

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