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Seizure Aetiology in Paediatric Patients: A Tertiary Healthcare Centre-Based Review of Magnetic Resonance Imaging

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ABSTRACT

Introduction: Children with epilepsy vary from adults not just in terms of their seizure clinical symptoms, but also in terms of aetiology. In aetiology, primary generalised epilepsy is considered hereditary, whereas most localization-related epilepsy has arisen as a consequence of a cerebral insult. Latest advances in brain imaging have contributed to the detection of more children of the origin of seizures.

Objective: Using magnetic resonance imaging to study the etiological characteristics of seizures in paediatric patients.

Methods: 150 paediatric patients under the age of 12 years with a generalized or partial seizure disorder or absence seizures were assessed in this hospital-based review. The patients underwent MRI scanning. Final diagnosis on radiological characteristics and in inconclusive cases was made; follow-up MRI and therapeutic response were diagnosed.

Results: Anoxia and hypoxic-ischaemic encephalopathy were found to be the most prevalent aetiology in 46 patients (41.8%), accompanied by cortical developmental malformations in 22 patients (20%), miscellaneous causes in 14 patients (12.7%), and infection in 8 patients (7.4%). Six patients (5.5 per cent) had phakomatosis. There were 4 patients each (3.6 per cent) with mesial temporal sclerosis and hereditary metabolic disorders and neoplasm. Only two patients (1.8 per cent) had vascular triggers.

Conclusion: Management must determine the cause of the seizure. MRI has been a versatile instrument in the imaging of paediatric seizure patients.

Key Words: Pediatric patients, Seizures, Magnetic resonance imaging, Anoxia and hypoxic-ischaemic encephalopathy

INTRODUCTION

Seizures result from the discharge of a community of neurons that is overly synchronous and prolonged. Children with epilepsy, particularly infants, vary not only in the clinical manifestations of their seizures but also in the aetiology and reaction to antiseizure medication from adults. In aetiology, primary generalised epilepsy is considered hereditary, whereas most localization-related epilepsy has arisen as a consequence of a cerebral insult. Epilepsy related to localization is said to be more prevalent in developing countries. Latest advances in brain imaging have contributed to the detection of more children of the origin of seizures. Magnetic resonance imaging (MRI) gives correct and subsequent localization and histological character of lesions. MRI is the technique of choice in partial seizures to determine the underlying cause.^{1,2} It increases the rate of

detection of such intracranial lesions, in particular those of vascular origin and meninges.^{3,4} The present research was performed to test the magnetic resonance imaging of the brain in the treatment of paediatric seizure disorder. In their effort to obtain a more precise method of discovering the essence of pathologies, the detection of etiological characteristics is of great benefit to both physicians and neurosurgeons.^{5,6} Centered on MRI results, the present research was conducted to study the etiological features of seizures in paediatric patients.^{7,8}

MATERIAL AND METHODS

150 paediatric patients with seizures referred to the MRI brain in a tertiary health centre were examined in this hospital-based prospective retrospective review. For this report,

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ethical approval was received from the institution's Research Committee and Ethical Committee.

Inclusion criteria

Both, paediatric patients (under 12 years of age) had a generalised or partial seizure or absent seizure disorder. Ethical committee clearance no DMIMS (DU) / IEC I 2020-21/9024.

Exclusion criteria

Patients unfit for MRI is deemed contraindicated for MR imaging concerning anaesthesia. Patients that are not able to get an MRI. The bad general state of a life support patient.

The parents/accompanying relatives received informed written consent. Full clinical background, history of birth and vaccination, family history, and previous patient history is noted. The points noted were seizure form, disease duration, and any related complaints. Physical test results have been noted for evidence of any neuro-cutaneous stigma and full CNS (Central nervous system) examination results. Routine blood studies have been observed, such as complete blood profile, liver and renal function checks, blood glucose levels, blood electrolyte levels, as recommended by the doctor. Other laboratory parameters have been conducted, such as biochemical leuko-dystrophy levels, serological infection tests, Cerebrospinal fluid (CSF) review. Electroencephalogram (EEG) and computed tomography (CT) scan results, if completed, have been reported. There were few instances of EEG documentation that correlated with imaging findings. For ferromagnetic objects, all patients were screened. MRI scanning was performed on patients (Philips Achieva 1.5 tesla, 16 channel). Adequate sedation was provided by the anaesthetist when necessary. Conventional MR imaging was conducted using aircraft sequences T1 weighted (TE 8.0ms, TR 480 ms), T2 weighted (TE 102.9 ms, TR 4780 ms), and FLAIR (TE 92.2 ms, TR 8002 ms), as shown below. In selected cases, post gadolinium (dose 0.1mmol / kg) enhanced MRI was performed in the axial, coronal and sagittal planes based on non-contrast or clinical suspicion findings. The axial output of DWI and GRE (Gradient Recalled Echo) in all situations. MR spectroscopy, MR venography and MR angiography, including TOF, were performed as needed. The final diagnosis was based on radiological and inconclusive cases; the diagnosis was made by MRI follow-up and reaction to treatment. Brain MRI results have been confirmed and documented.

RESULTS

Out of a total of 150 patients included in the report, 58 males and 24 females were 0-3 years of age, 24 males and 6 females were 4-6 years of age, 14 males and 10 females were 7-9 years of age, while 6 males and 8 females were 10-12 years of age. In our sample, the overall age group for male and

female patients was 0-3 years, followed by 4-6 years. 110 patients (73.3 %) had positive MRI findings out of 150 patients surveyed, while 40 patients (26.7%) had regular MRI without detectable lesions. Various forms of seizure disorders have been categorised according to ILAE guidelines. Out of 150 patients, 102 (68 %) had generalised seizures, 36 (24 %) had focal seizures, while 12 (8 %) had an unexplained onset. In our study, generalised seizures were the most common type of seizure. The study included 46 patients (41.8 %) with anoxia and hypoxic-ischemic encephalopathy (HIE). Cortical developmental malformations (CDM) were next found in 22 patients (20%), followed by miscellaneous causes in 14 patients (12.7%), and 8 patients (7.4%) were infected. Six patients (5.5 %) had phakomatosis. Four patients (3.6 %) each had Mesial temporal sclerosis and hereditary metabolic disorders and neoplasm. There were only two patients with vascular causes (1.8 %). Therefore, in our research, the most prevalent aetiology was anoxia and hypoxic-ischemic encephalopathy, accompanied by cortical development malformations. The correlation between lesions and age was not statistically important. 110 patients with seizures had an irregular MRI in our study. The most common aetiology in the 0-3 age group was anoxia and HIE in 26 patients (41.9 %), followed by cortical growth malformations in 10 patients (14.7 %). In 8 patients, miscellaneous causes were seen (12.9 %). Anoxia and HIE and malformations of cortical development were seen in 8 patients in the age group of 4-6 years (33.3 %) each. The most common aetiology in the 7-9 age group was anoxia and HIE in 10 patients (62.5%). The most common aetiology in the 10-12 age group was anoxia and HIE, cortical developmental malformations, phakomatosis and miscellaneous causes in 2 patients (25 %) each. Therefore, in our research, the most common aetiology in infants and young children (0-3 years) and older children of the age group (7-9 years) was anoxia and HIE, while in the age group (4-6 years), anoxia and HIE and cortical growth malformations were common causes. No single common cause was found within the age group (10-12 years).

DISCUSSION

For seeking an appropriate cure, the detection of the cause of seizures is important. MRI has emerged as a versatile method in the assessment of patients with central nervous system disorders, with its high spatial resolution, excellent intrinsic soft-tissue contrast, multi-planar imaging capacity, and lack of ionising radiation. In our sample of 150 patients, 69.3 per cent had generalised seizures, the highest number of patients. Our study coincides with the study performed by Rasool A et al, in which generalised seizures were the main type of seizures in as many as 42% of patients⁴. Our study also coincides with the Chaurasia et al study, in which generalised seizures accounted for 76.7 per cent of the highest number of

patients seen.⁹ In this study, 110 patients (73.3 %) of a total of 150 patients had abnormal MRI outcomes. Our analysis is comparable with the study performed by Kuzniecky et al in which MRI revealed anomalies in 84 % of patients.¹⁰ In our research, MRI anomalies were observed in 88.9 per cent of patients with focal seizures, 70.6 per cent of patients with generalised seizures, and 50 per cent of patients with uncertain onset. Our study is similar to the study by Khodapanahandeh et al, in which an essential association between abnormal neuro-imaging and focal seizure was found.¹¹ Of the 150 patients included in our study, 110 (73.3%) had an irregular MRI. Out of 110 patients, 62 (56.4%) were in the 0-3 year age range, with anoxia and HIE being the most common aetiology seen in 26 (41.9%) patients. Cortical developmental malformations were also prevalent in this age group, occurring in 10 patients (13.5%) accompanied by miscellaneous causes in 8 patients (12.9%). Of the 110, 24 patients (21.8 %) in the 4-6 age group, anoxia and HIE and cortical developmental malformations were frequent causes in this age group and 33.3 % were seen in 8 patients each. Out of 110, 16 patients (14.5 %) were in the 7-9 age group. The most common aetiology seen in 10 patients (62.5 %) was anoxia and HIE in this age group. Out of the 110 patients (7.3%) in the 10-12 age group, no single typical aetiology was found in this age group. Our study corresponds well with the Khreisat W H study in which children with seizures below the age of 2 years were tested for aetiology in the age range of 0-3 years.¹² Perinatal asphyxia seen in 55 % was the most common etiological factor observed in this study, followed by CNS infection in 15 %, central nervous system defects in (9 %), head trauma in (8 %), congenital and family disorders in (8 %) and prematurity in (5 %). Our thesis also correlates well with the previous analysis (n=31).¹³ In 35 %, hemorrhagic in 26 %, metabolic disruptions and cerebral dysgenesis in 16 % and uncertain in 23 %, seizure aetiology was found to be hypoxic-ischemic. In neonatal seizures, the MRI observed a remarkably high frequency of brain lesions. Nearly half of these were of prenatal origin and hypoxic and/or hemodynamic causes which essentially be due to pathogenesis. Our study coincides with the Durá-Travé et al. study, which reported children between 1 month and 15 years of age at the time of epilepsy diagnosis. White-matter lesions (27.6%), volume loss (19.6 %), grey-matter lesions (19.6 %), and ventricular enlargement (12 %) were the most common anomalies. In our sample, 41.8% of patients had anoxia and hypoxic-ischaemic encephalopathy, accompanied by cortical developmental malformations that were seen in 20 % of patients. 12.7 % of patients suffered from multiple causes. Infection constituted 7.4 % of patients followed by phakomatoses in 5.5 % of patients. Mesial temporal sclerosis, hereditary metabolic disorders and neoplasms accounted for 3.6% of patients, and vascular causes accounted for 1.8% of patients, with the least common aetiology. Out of 15 patients in the NK Rollins et al study, five patients had focal is-

chaemic cerebral hemispheric and/or basal ganglia and brain stem damage. Six patients had diffuse cerebral oedema, of which five had oedema of the basal ganglia; one had oedema of the brain stem.¹⁴ One patient with venous infarcts had superior sagittal sinus thrombosis. Three patients had MRI studies that were regular. The MRI was positive in 68 % of patients. The study showed hypoxic-ischemic aetiology in 35 %, hemorrhagic aetiology in 26 %, metabolic disorders and cerebral dysgenesis in 16 % and unknown cause in 23 % as the main cause of seizures.¹⁵ Our analysis is comparable to the above studies and demonstrates the most common aetiology in paediatric seizure disorder as hypoxic-ischemic encephalopathy.

CONCLUSION

Management must determine the cause of the seizure. MRI has emerged as a versatile method in the imaging of paediatric patients with seizures due to high spatial resolution, excellent intrinsic soft-tissue contrast, multi-planar imaging capability and lack of ionising radiation. To conclude, we found that neuro-imaging, especially MRI, played an incredible role in the etiological diagnosis of childhood seizures. Good neurological symptoms and symptomatic seizures were closely associated. Positive EEG results are also correlated significantly with idiopathic seizures. Finally, in the future, a large prospective study is required to assess and validate the findings and interpretation produced in this study.

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Table 1: Age and Sex-wise comparison of patients (N=150)

| Age Group (yrs) | Male | Female | Total |
|-----------------|------|--------|-------|
| 0-3 | 58 | 24 | 82 |
| 4-6 | 24 | 6 | 30 |
| 7-9 | 14 | 10 | 24 |
| 10-12 | 6 | 8 | 14 |
| Total | 102 | 48 | 150 |

Table 2: Distribution of various types of etiologies according to age group (N=110)

| Type of Etiology | 0-3 yrs | 4-6 yrs | 7-9 yrs | 10-12 yrs | Total |
|--|---------|---------|---------|-----------|-------|
| Mesial temporal sclerosis | 4 | 0 | 0 | 0 | 4 |
| Malformations of cortical development | 10 | 8 | 2 | 2 | 22 |
| Phakomatoses | 4 | 0 | 0 | 2 | 6 |
| Inherited metabolic disorders | 4 | 0 | 0 | 0 | 4 |
| Anoxia and hypoxic ischemic encephalopathy | 26 | 8 | 10 | 2 | 46 |
| Infection | 4 | 2 | 2 | 0 | 8 |
| Neoplasm | 2 | 2 | 0 | 0 | 4 |
| Vascular | 0 | 2 | 0 | 0 | 2 |
| Miscellaneous | 8 | 2 | 2 | 2 | 14 |
| Total | 62 | 24 | 16 | 8 | 110 |