Research article

Abnormalities in MRI brain in Sri Lankan children with epilepsy: A descriptive study

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Abstract

Epilepsy is an important medical condition among children, with an estimated prevalence of around 6/1000 among children in Asian countries. Neuroimaging has a very important role in the diagnostic workup and treatment planning of epilepsy. Magnetic resonance imaging remains the most useful structural imaging modality for epilepsy.

The purpose of this study was to identify the distribution of MRI brain abnormalities among children with epilepsy in Sri Lanka and to correlate with their clinical findings.

Data were collected from the patients with epilepsy in the age group of 1 to 15 years, who were referred for MRI brain. Patient's demographic and clinical data were collected by an interviewer-based data collection sheet. All the MRI studies were performed on a 1.5 tesla MRI machine. Findings of MRI were categorized according to ILAE guidelines for imaging infants and children with recent-onset epilepsy.

Out of 175 patients, 88 (50.3%) had normal MRI results and 87 (49.7%) had at least one MRI abnormality. Among the patients with abnormal results, nonspecific findings were seen in 46 patients (52.9%), specific abnormalities were seen in 36 patients (41.4%) and non-related findings were seen in 5 patients (2.6%). There was no significant relationship between the seizure type and the proportion of abnormalities.

The proportion of MRI brain abnormalities among the children with epilepsy in our population is higher than reported in other countries.

There is a poor correlation of MRI brain abnormalities with the type of seizure.

Keywords: Epilepsy, Seizure, MRI brain, Children

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Introduction

Epilepsy is an important medical condition among children. The reported prevalence of epilepsy in children has quite a wide range. The prevalence of childhood epilepsy is higher in developing countries than in developed countries. For example, in a review for Asian countries, the prevalence of epilepsy among children was found to be around 6/1000. In contrast, this in European countries ranges from 3.2 and 5.1/1000) (1).

Epilepsy has significant health and socio-economic impact upon the affected individuals and families. Therefore, appropriate diagnostic workup leading to correct management of epilepsy is important. The aetiology of childhood epilepsy is broad. Medical imaging plays an important role in the diagnostic workup and the process of decision making of appropriate treatment options, especially identifying structural lesions amenable for surgery in patients with epilepsy refractory to medical treatments.

The imaging of epilepsy patients has advanced significantly over the last two decades. MRI brain is the core of epilepsy imaging, and most of the recent advances are advances in MRI techniques. These include higher magnet strength and new MRI sequences such as volumetric imaging and diffusion tensor imaging that are more sensitive for subtle structural changes. In addition, fusion imaging techniques such as MRI source imaging and Magnetic Resonance Imaging/ Positron emission Tomography (MRI/PET) are further advances in imaging. Three Tesla MRI scanners have better sensitivity for identifying subtle focal lesions responsible for epilepsy when compared to the lower magnet strength MRI scanners (2).

According to the guidelines for imaging infants and children with recent-onset epilepsy published by ILAE (3), imaging findings can be categorized as follows,

1. Nonspecific findings (e.g., periventricular leukomalacia, atrophy).
2. Static remote lesions (e.g., porencephaly, malformations of cortical development).
3. Focal lesion responsible for the seizures that do not require immediate intervention but would be potentially amenable to epilepsy surgery (e.g., focal cortical dysplasia or mesial temporal sclerosis).
4. Subacute or chronic process that has therapeutic implications [e.g., requires more immediate intervention (brain tumour), or that has important diagnostic or prognostic implications (e.g., leukodystrophies, metabolic disorder)].
5. An acute process that requires urgent intervention (e.g., hydrocephalus, acute stroke or haemorrhage, encephalitis, metabolic cytopathy)

Most of the advanced imaging techniques are not readily available for children in lower-middle-income countries. At The Lady Ridgeway Hospital for Children (LRH), we have only a 1.5 tesla MRI machine with only basic MRI sequences for the imaging of epilepsy patients. The purpose of this study was to identify the distribution of MRI brain abnormalities among the children with epilepsy referred to the Department of Radiology at LRH and to correlate with their clinical findings.

Materials and methods

Ethics approval

Ethical approval for this descriptive study was granted by the ethical review committee of LRH.

Patients and setting

Data for the study was collected from the epilepsy patients in the 1-15 years age group, referred to the Radiology Department at the LRH for MRI brain from August 2017 to April 2018. Patients who were not examined by a pediatric neurologist, patients with an uncertain diagnosis of epilepsy and patients with acute head trauma or other acute brain insult were excluded from the study.

LRH is the largest paediatric hospital in the country, and it is the final referral centre for children in most parts of the country. Therefore, the patient population of the hospital represents the entire country.

Data collection

Demographic and clinical data were collected by an interviewer-based data collection sheet. Classification of seizures was done according to 2017 ILAE classification as focal onset, generalized onset and unknown onset (4). Information from the referral letter and clinic records were used to fill the data collection sheet. When required, parents or guardians of the child and referring clinical team were contacted.

All the patients were imaged in Siemens 1.5 T MRI machine according to our department MRI protocol for epilepsy, which includes T1W, T2W, T2 FLAIR and T2* axial, T1W sagittal, and T2W coronal 5mm sections, T2W, T2 FLAIR, and T1 IR oblique coronal of temporal lobes 3mm sections, diffusion-weighted imaging, T1W 1mm volume of the brain with sagittal, coronal, and curve range multiplanar reformatting and T1W post-contrast images when required. Findings of MRI brain were collected from the report issued by a radiologist with pediatric radiology proficiency and entered into the same data collection sheet. Findings of MRI were categorized according to ILAE guidelines for

imaging infants and children with recent-onset epilepsy (3).

All the patients with epilepsy who were referred to our department for MRI brain, who met inclusion criteria were included. The table "estimating a population proportion with specified absolute precision" by Lwanga and Lameshow in the manual of the World Health Organization for sample size determination in health studies was used to calculate the sample size of the study(5). The sample size was calculated using the anticipated proportion of 22% of abnormalities based on a previous study done by Durá-Travé T et al. (6). The confidence interval of 90% and absolute precision of 5 percentage points gave a sample size estimate of 173.3.

Results

There were 175 patients in the group, with 103 male patients (58.9%) and 72 female patients (41.1%). Age distribution was from 1 year to 15 years with a mean age of 6.5 years (standard deviation 0.31). The onset of seizure was focal in 100 patients (57.1%), generalized in 66 patients (37.7%) and unknown in 9 patients (5.1%). MRI brain findings categorized according to ILAE guidelines are presented in table 1.

Table 1: MRI brain findings according to the category of abnormality

Category of MRI result	Number of patients (%)
Normal	88 (50.3%)
Nonspecific findings	46 (26.3%)
Static remote lesions	11 (6.3%)
Focal lesion responsible for the seizures that do not require immediate intervention but would be potentially amenable by epilepsy surgery	15 (8.6%)
The subacute or chronic process that has therapeutic implications	6 (3.4%)
An acute process that requires urgent intervention	4 (2.3%)
Non-related findings	5 (2.6%)

The distribution of nonspecific and specific MRI brain abnormalities are presented in table 2.

Among the 100 children with focal onset seizures, 48 (48%) had normal MRI brain results, and 52 (52%) had abnormal results. Out of abnormal MRI results, 27 (51.9%) had nonspecific findings, and 23 (44.2%) had specific abnormalities. Among the 66 children with generalized onset seizures, 35 (53%) had normal MRI results, and 31 (47%) had abnormal results. Out of abnormal results, 18 (58.1%) had nonspecific findings, and 10 (32.3%) had specific abnormalities. There was no significant difference of percentages of abnormal brain results or percentage of specific brain abnormalities between focal onset seizure group and generalized onset seizure group ($X^2 = 0.40$, P = .53 and $X^2 = 1.16$ P = .28 respectively). Among nine patients with unknown onset seizures, 5 (55.6%) had normal MRI results, and 4 (44.4%) had abnormal results. Out of abnormal results, 2 (50%) were nonspecific findings, and 2 (50%) were specific abnormalities.

Table 2: Distribution of MRI brain abnormalities

MRI brain abnormality	Number of patients
Cerebral atrophy	24
Leukomalacia or white matter signal abnormalities	21
Thalamic signal abnormality	1
lissencephaly-pachygyria spectrum abnormalities	4
polymicrogyria	2
grey matter heterotropia	1
hemimegaloencephaly	1
focal encephalomalacia	3
focal cortical dysplasia	4
unilateral MTS	8
bilateral MTS	1
hypothalamic hamartoma	2
hypomyelination	2
vanishing white matter disease	1
cystic leukoencephalopathy with megalencephaly	1
CNS angiitis	1
possible neuronal ceroid lipofuscinosis	1
acute infarctions	3
venous sinus thrombosis	1
cerebellar atrophy	2
pineal cyst	1
empty Sella syndrome	1
dysgenesis of corpus callosum	1

Discussion

We reviewed 175 children with epilepsy who were referred for MRI brain and found that the proportion of children with MRI brain abnormalities is higher than the values reported in the literature with the absence of a significant relationship between the seizure type and the proportion of children with MRI brain abnormalities.

Although similar studies from Sri Lanka are unavailable, compared to the results from elsewhere, 49.7% of the participant children with epilepsy in this study to be having MRI brain abnormalities is remarkably higher than the values reported previously. According to a similar study done by Durá-Travé T et al. (6), the

prevalence of significant MRI abnormalities among children with epilepsy in the age group 1 month to 15 years was 21.9%. According to this study, the most common abnormalities were white-matter lesions (26.8%) and volume loss (18.3%). Grey-matter lesions were seen in 21.8% of patients, and ventricular enlargement was seen in 11.3% of patients. Although their categorization of imaging findings is different to us, volume loss and white matter lesions collectively form the main group of abnormalities, which is similar to our study. Further, according to their study, the prevalence of abnormalities was higher in infants, which was 42.3%, compared to that of 18.2% in childhood and 15.9% in adolescents. Considering the fact that we have not included infants in our study the difference between the proportions of MRI abnormalities of two studies become more significant. In another study of 200 children with recent-onset epilepsy in the age group of 1 to 15 years, the proportion of MRI brain abnormalities was 28.7%, which is less than our study (7). Again, similar to our study, the most common abnormalities were cerebral atrophy and white matter signal abnormalities. Because the distribution of MRI abnormalities in our study was similar to studies done by other researchers, it can be assumed that our sample was a representative sample of the population.

The reason for the higher proportion of MRI brain abnormalities in our study could be multifactorial. The true incidence of brain abnormalities in children with epilepsy in our population could be higher than in other countries. However, this needs to be confirmed with further studies. Due to the limited availability of MRI scanners in our hospitals, clinicians and radiologists are cautious to select the patients and only the patients with a very high possibility of having a structural lesion may get imaged. This also could be contributing to the higher proportion of MRI abnormalities in our study.

Our study was performed based on MRI studies done in a 1.5-tesla scanner, which is believed to have a lesser sensitivity than a 3-tesla scanner for abnormalities related to epilepsy. On the other hand, we do not have functional imaging modalities readily available to aid the interpretation of MRI studies. Therefore, the true proportion of brain abnormalities among children with epilepsy in Sri Lanka could be even higher. This means the role of imaging is more important than expected for treatment modification, including epilepsy surgery and determining prognosis for children in our population.

In our study, the proportions of MRI brain abnormalities were not significantly different between the types of seizure, categorized according to seizure onset as the focal, generalized or unknown onset. It is accepted that localization-related seizures demonstrate higher proportions of MRI brain abnormalities. However, our study sample was selected from patients who were referred for MRI brain by paediatric neurologists. Since patients with idiopathic epilepsy syndromes are not imaged, it can be assumed that our patient sample represents patients with cryptogenic epilepsy or symptomatic epilepsy. This can be the reason for the absence of significant differences in MRI abnormalities between seizure types in our study. Similar results are seen in previous studies that were designed similar to our study. In a study of 200 children with epilepsy aged 1 to 15 years, the proportions of MRI abnormalities were 21.4% and 23.2% for focal and generalized epilepsy, respectively (7).

Conclusion

We conclude that the proportion of MRI brain abnormalities among the children with epilepsy in our population is higher than reported in other countries. Therefore, we recommend that the availability of imaging for children with epilepsy in our population should be expanded. There is a poor correlation of MRI brain abnormalities with the type of seizure. However, this needs to be evaluated further with future studies.

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