



Role of Magnetic Resonance Imaging of Brain in Paediatric Patients with Partial Seizures

Ravi Kumar Parihar, Ashok K. Gupta, Ghanshyam Saini, Ghanshyam Dev *

Abstract

The study was carried out for one year to find out the role of magnetic resonance imaging brain in pediatric patients with partial seizures. Children from age 28 days to 18 years who presented with partial seizures were included and the information obtained from the history, clinical examination and investigations particularly MRI brain were noted down and analyzed. Maximum numbers of patients were in the age group of 5-10 years (48.84%). 27.91% had simple seizures and the rest 72.09% had complex partial seizures with none having secondary generalization. The risk factor for seizures were present in 54.19% of cases. Most of the lesions involved parietal region (44.19%) followed by temporal lobe involvement in 13.95%. 55.81% had findings of neurocysticercosis (NCC), 29.91% showed tuberculoma, 8.30% had normal MRI findings and 6.98% had findings suggestive of cerebritis, sturge weber syndrome and porencephalic cyst. 89.74% lesions showed contrast enhancement on MRI. Contrast enhancement MR altered the radiological diagnosis in many patients with partial seizures. It helped to diagnose infections like tuberculoma and NCC in various stages of evolution and also helped to rule out other structural lesions, thus helping in planning modalities of treatment.

Key Words

Magnetic Resonance Imaging (MRI), Partial Seizures, Neurocysticercosis(NCC), Tuberculoma

Introduction

Seizures are common neurologic problem in all age groups attending neurological units of large urban teaching hospitals; occur in approximately 10% of children. Presence of seizures constitutes a symptom of an underlying central nervous system disorder that requires thorough investigations and management plan. Epileptic seizures are caused by cerebrocortical hyperactivity, partial onset seizures begin in localized area of cerebral cortex. Less than one third of the seizures in children are caused by epilepsy, a condition in which seizures are triggered recurrently from within brain(1). Lesions in temporal lobe are probably most likely to cause seizures. Till date the classification proposed by International League against Epilepsy is most widely accepted and gives important guidelines in determining prognosis and predicting response to treatment. The etiological factors of epilepsy differ markedly in children as compared to adults. Partial seizures account for a large proportion of childhood seizures, up to 40% in some series. Classified

as simple and complex, consciousness is maintained with simple partial seizures. Common causes include inflammatory granulomas, atrophic lesions, birth asphyxia, head trauma and neoplasm. Neurocysticercosis has emerged as a common cause in India. Neurocutaneous syndromes, arteriovenous malformations and infarcts are less frequent (2). The relationship of origin of a focal seizure, the epileptogenic focus to a structural lesion is based on three assumptions: Partial seizures are due to pathologic abnormality thus there is always a lesion, if a lesion can be shown in a patient with seizures then it is highly probable that seizures are the result of that lesion and the seizures focus originates in the vicinity of the lesion, but precise site and the extent of focus is not necessarily the same as that of the lesion.

Recently, there are many investigations and modalities available for diagnosis and searching for cause of seizures such as EEG, CT scan, MRI, SPECT as well as PET. But introduction of MRI into clinical practice during the

From the PG Department of Pediatrics & *Radiodiagnosis Govt Medical College, Jammu J&K- India

Correspondence to :Dr. Ravi Parihar, Registrar, PG Department of Pediatrics, S.M.G.S Hospital, Government Medical College Jammu, J&K-India



past 20 years has substantially revolutionized the evaluation and management of epilepsy and seizures disorder. Role of imaging is to localize the origin of focal seizure and identify its cause. This information is important in treatment and prognosis of affected patients. Being much more sensitive than computed tomography (CT), MRI is the technique of choice to identify underlying cause in partial seizures (3). Even when enhanced MRI has been compared with contrast enhanced CT; the superiority of MRI is seen especially in temporal lobe origin, since lesions in inferior temporal lobes may be inapparent on CT scan because of beam hardening artifacts (4). The accuracy of cranial MR diagnosis has been improved by introduction of paramagnetic contrast agent gadopentetate demeglumine (5). It increases the detection rate of certain intracranial lesions especially those of vascular nature and those involving the meninges (6). It significantly improves radiologic specificity particularly with regard to defining the extent or nature of certain neoplasm and the differentiation of aggressive from benign processes (7). Physiologic imaging provided by SPECT and PET provide information that is complimentary to MRI findings. However, the physiologic changes seen with SPECT and PET may be more widespread and less specific than the focus defined when using MRI, EEG and surgery (8). In India a ring or disc enhancing lesion is the commonest accompaniment of focal epilepsy and at least one third of these lesions are tuberculomas (9). Cerebral cystercosis is the commonest parasitic infection in India (10). Most children (>80%) present with seizures, particularly partial seizures (11). Diagnosis is made by rather CT or MRI, single enhancing lesions are most common finding. MRI imaging is helpful in the differential diagnosis of tuberculomas and neurocysticercosis.

Since only few studies have been made regarding the MRI findings in children with partial seizures. This prospective study examines the value of MRI brain to identify the region of cerebral origin, etiology, and medical or surgical management of the patients with partial seizures.

Material and Methods

This study was conducted in patients with partial seizures admitted in the Department of Pediatrics Government Medical College Hospital, Jammu for one year. A special Proforma was designed and the information obtained from the history, clinical examination and investigations (MRI in particular) were noted down. All the patients in the study group were contacted personally, examined clinically and investigated as per requirements. A detailed clinical and MRI examination was carried out in all cases on the lines of Performa. All

Table 1. Risk Factors for Seizures in the Patients of the Study Group

Risk factors	Number of patients	%age
Family h/o seizures	3	6.98
H/o perinatal insult	2	4.65
H/o contact with tuberculosis	4	9.30
H/o fever	10	23.26
Unknown /Not known	24	55.81
Trauma/ear discharge/previous CNS infection/delayed milestones	-	-
Total	43	100%

Table 2. Combined Location Distribution of Lesions on MRI Examination in the Patients

Lesion location	Number of cases	%age
Parietal	19	44.19
Temporal	6	13.9
Occipital	0	0
Frontal	2	4.65
Multiple regions	12	27.91
Normal	4	9.30
Total	43	100

the children from age 28 days to 18 years who were having simple partial seizures, complex partial seizures and partial seizures with secondary generalization were included whereas seizures in neonates, patients without the evidence of partial seizures from the clinical review and those who were with generalized seizures were excluded. MRI was performed after obtaining informed consent from the patient or his/her attendants and in younger/non-cooperative patients' sedation by triclofos sodium 20 mg/kg per dose orally was required for the procedure. MRI examination was carried out on Siemens magnetum symphony, 1.5 Tesla Helium cooled superconducting MR scanner. Dedicated head coils were used for multiplanar imaging of the brain. MRI was performed in axial, coronal and sagittal planes in varying thickness from 5-10 mms using standard T1 and T2 weighted special sequences wherever required. Plain imaging was followed by intravenous contrast. On T1 WSE fat suppressed using gadolinium DTPA in dose of 0.2 mmol/kg body weight as contrast. By correlating MR findings with clinical and laboratory results, final diagnosis was made. However, in a recent study Phal PM *et al* (12) emphasized that in evaluation of epilepsy, MRI at 3 Tesla performed better than 1.5 Tesla MRI in image quality, detection of structural lesions and characterization of lesions.

Table 3. Etiological Distribution of Lesions on the Basis of MRI in the Subjects of the Study Group

Age group	Tuber culoma	Neurocysticercosis	Normal Study	Miscellaneous	Total
28 days-5 years	3	3	3	0	9
>5-10 years	6	12	1	2	21
>10-18 years	3	9	0	1	13
Total	12 (27.91%)	24 (55.81%)	4 (9.30%)	3 (6.98%)	43 (100%)

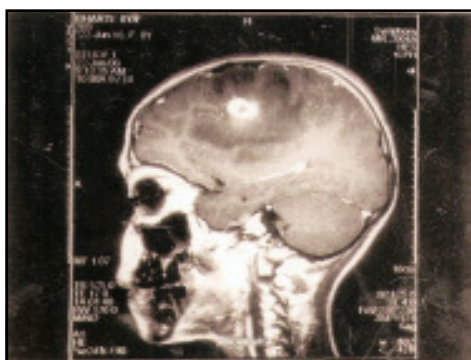


Fig 1. Thick Irregular Contrast Enhancing Ring with Marked Hypointense Oedema seen on post Contrast TIW Sagittal in Right Parietal lobe (Tuberculoma)

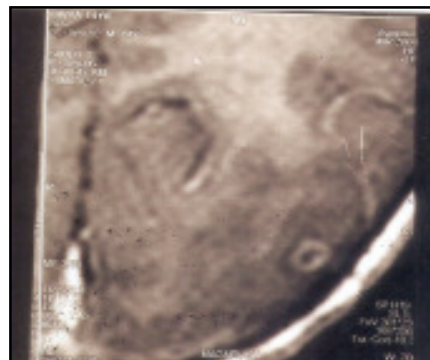


Fig 2. Post gadolinium TIW Axial Showing Ring Enhancing Lesion with thin Regular Rim Suggestive of NCC (Colloid Vesicular Stage)

Results

The present study comprised of 43 pediatric patients aged 28 days to 18 years with partial seizures. The subject fulfilling the inclusion criteria were subjected to MRI in the Postgraduate Department of Radio diagnosis and imaging in Government Medical College Hospital, Jammu. The maximum number of patients were in the age group of >5-10 years (48.84%). Family history of seizures was present in 6.98% of subjects, Birth anoxia in 4.65%, history of contact with patients of tuberculosis in 9.30%, history of fever in 23.26% whereas rest 55.81% had no known risk factors for seizures as depicted in *table 1*. In terms of seizure distribution pattern, 27.91% had simple partial seizures and rest 72.09% had complex partial seizures, with none of the patients having partial seizures with secondary generalization. MRI revealed focal abnormalities in 39(90.70%) of the cases. In the rest 4(9.30%) MRI study was normal. Lesions mostly involved the parietal regions (44.19%) followed by multiple regional involvement (27.91%), temporal lobe in 4.65% of the cases (*Table 2*). As far as the etiological distribution is concerned as shown in *table 3*, neurocysticercosis formed the major chunk. 55.81%, of the total subjects followed by tuberculoma 27.91%, 9.30% of the subjects had normal MRI findings and rest 6.89% had miscellaneous findings (cerebritis, sturge Weber syndrome, and porencephalic cyst, one each).MRI findings without and with contrast enhancement of various

lesions in the study group were as follows, out of total 39 patients which showed lesions on MRI study, MRI Scan of 35(89.74%) patients showed post contrast enhancement while as scan of 4(10.26%) patients did not. Out of total 24 patients with neurocysticercosis, 12 (50%) patients were having MRI findings suggestive of colloidal vesicular stage, 7(29.22%) patients in granular nodular stage, and 2 (8.33%) patients each in nodular calcified and multiple stage and only 1 (4.12%) patient was found to be in vesicular stage of evolution. In the study group out of 43 patients 5 (11.63%) had positive Mantoux test and the rest 38(88.37%) had negative Mantoux test. All the patients who had positive Mantoux test were having tuberculoma on MRI findings.

11 patients were subjected to CSF examination. Only one revealed findings of meningitis rest all showed normal CSF examination. 1 patient had neurocutaneous stigmata in the form of hemangioma on right side of the face. This patient also had left sided complex partial seizure with hemi paresis on the left side. MRI showed findings suggestive of Sturge Weber syndrome. 17 patients out of the total 43 had raised ESR, 8 patients were from tuberculoma group, 7 were from neurocysticercosis group whereas one had cerebritis on MRI and the remaining one had normal MRI study. On chest X-ray two patients had findings of consolidation and both the patients were diagnosed tuberculoma on MRI.



Discussion

Seizure is a paroxysmal alteration in neurologic function resulting from abnormal excessive neuronal activity. The pathophysiological basis of seizure is loss of normal regulation excitation and inhibition, resulting in a state of relative hyper excitability. For localization of an epileptogenic focus MRI has emerged as a single most valuable tool because of its excellent soft tissue contrast, allowing for detailed depiction of anatomy, freedom from beam hardening artifacts in basal brain that occur with CT and capacity for multiplanar imaging. As most clinical questions relate to the cause of seizure, MRI appears to be more useful than PET or SPECT for routine diagnosis making MRI the imaging study of choice for assessment of epilepsy (8). Family history of seizures, birth anoxia, contact with tuberculosis and fever was present in 6.98%, 4.65%, 9.30%, and 23.26% of cases respectively whereas the rest 55.85% had no known risk factors for seizures. In one of the study conducted in the past family history of seizures was present in 9.9%, perinatal insult in 9.9%, trauma in 3.5%, previous CNS infections in 13.6% and previous history of febrile seizures in 2.2% (13).

In our study complex partial seizures constituted 72.09% while those with simple partial seizures 27.19%. There was no patient of partial seizures with secondary generalization. This could be explained due to poor history put forth by the patients as most of the patients belonged to illiterate and low socio-economical background. However in a study conducted in the past out of 150 cases studied, 79 were of complex partial seizures while 10 were of simple partial seizures, 42 had both complex partial seizures and simple partial seizures and the rest 19 had partial seizures with secondary generalization (5). Concept of epileptogenic focus is supported by the imaging studies. Partial epilepsy as opposed to generalized epilepsy is associated with a structural lesion of brain (4). MRI using intravenous contrast was done in all the patients. In our study contrast enhanced MR altered radiological diagnosis in many patients with partial seizures. It helped to diagnose infections, vascular malformation and rule out other various benign causes of seizures such as Mesial Temporal Sclerosis, Gliosis, Cortical dysplasias, Heterotropias etc. 89.74% of lesions showed contrast enhancement on MRI while as 10% of lesions did not. Hence, most lesions causing partial seizures are contrast enhancing indicating disruption of blood brain barrier (BBB). This makes post contrast MRI more valuable in diagnosing the etiology of partial seizures supported by some authors who studied the enhancement pattern of various lesions to differentiate various structural lesions (5). This comparison helped us to arrive at specific

diagnosis as different lesions have typical enhancement patterns. The high rate of positivity in our study can be explained by the occurrence of unique phenomenon of ring enhancing lesions (single or multiple). This is because both tuberculomas and cysticercosis are endemic in our region. These findings have been reported in only a few western studies probably because tuberculosis and neurocysticercosis are very rare in that part of the world. In the present study of 43 cases 37(86.05%) belong to infections out of which neurocysticercosis constituted 24(64.86%), tuberculoma 12 (32.43%) cerebritis in 1 patient (2.70%), 4 showed normal MRI findings and 2 developmental anomalies, one Sturge Weber syndrome and one Porencephalic cyst. These findings were entirely different from various studies in the past (14, 15). Our study also contrasts well with one latest study conducted by Amirjalali S *et al* (16) who reported abnormal MRI in only 28.5% of pediatric patients and consisted of brain atrophy(10%), increasing white matter signal intensity in T2-weighted images(8%), benign cysts(5%), brain tumour (4%) and vascular abnormalities(1.5%). The reason again can be attributed to the much lesser incidence of infectious diseases in that part of world and also the study group being comprised of all type of epileptic patients instead of partial seizures as in our case. Surgical treatment of certain disorders such as tumors, vascular malformations or hippocampal sclerosis can eliminate seizure activity. Thus MR imaging was a critical investigation in deciding the line of treatment medical or surgical and the outcome depends on the cause and location of epileptogenic and the outcome depends on the cause and location of epileptogenic source, MR imaging is necessary in preoperative evaluation. In developing countries like India, tuberculomas are frequently confused with cysticercosis granuloma. Neuroimaging like MRI or CT scan features help to differentiate between the two conditions (17). Tuberculoma measures >20 mms in diameter, frequently irregular in outline and are always associated with marked cerebral oedema (leading to midline shift) and progressive focal neurological deficit. In our study tuberculoma was the second most common cause of partial seizures, a total of 27.91% of subjects in the study group.

12 subjects showed multiregional involvement (27.91%) whereas in a study done in the past showed 10.9% of multiregional involvement (14). Both studies show the dominance of parietal lobe involvement (18). MRI shows better resolution to detect the scolex and often reveals more cysts than does CT. In the present study 24 cases were attributed to NCC infection. Poor sanitation may be the single most important social factor underlying the increased prevalence of NCC and



subsequent epilepsy in tropical countries. In our study also the mural nodule (Pea in pod) could be picked up in some cases of NCC granulomas. Some authors described MRI findings of NCC depending on the stage in the evolution of infection as: Vesicular, Colloid vesicular, Granular nodular, Nodular, calcified, Mixed stages (19, 20, 21). In the present study maximum cases i.e., 50% belong to colloid vesicular stage, 29.22% were in granular nodular stage, 8.33% each in nodular calcified stage and mixed stages while only 4.8% cases belong to vesicular stage. All the patients who had positive Mantoux test were having tuberculoma in MRI finding. Thus pathological lesions on MRI corresponded to the cause of partial seizures in majority of cases and helped to plan further management of patients with partial seizures.

In a systemic review of neuroimaging in epilepsy, Roy & Pandit (22) have recommended that MRI is the procedure of choice in epileptic patients. The only disadvantages of MRI are its unavailability for larger number of patients, higher cost, and the requirement for longer time period of scanning. MRI is particularly indicated when patient has apparently generalised seizure but does not respond to antiepileptics, develops progressive neurological or neuropsychological deficit or who presents with partial onset seizures with or without secondary generalization.

Conclusion

As concept of epileptogenic focus is supported by the imaging studies, partial seizures as opposed to generalized seizures are associated with structural lesions of the brain. Contrast enhanced MR altered radiological diagnosis in many patients with partial seizures. It helped to diagnose infections like tuberculoma and NCC in various stages of evolution which are endemic in our region and helped to rule out other structural lesions, thus helping in planning the modalities of treatment. New advances in MRI such as shaped surface coils improvement in signal to noise ratio, calculation of T1 and T2 relaxation constants, paramagnetic agents and in vivo metabolic studies with MR spectroscopy promise to enhance the potential utility of MRI in seizures in general and partial seizures in particular.

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