J Nepal Health Res Counc 2011 April;9(18):56-60

Magnetic Resonance Neuroimaging in Patient with Complain of Seizure

Koirala K[1]

[1]DIRC MRI, Lazimpat, Kathmandu, Nepal.

ABSTRACT

Background: MRI is the preferred modality to investigate seizure as diagnostic yield is higher and more specific due to its varied applications. Total of 160 brain MR images of patients suffering from seizure during one year period was evaluated. All seizure cases underwent specific protocol for imaging that targeted hippocampal/mesial temporal lobe imaging.

Methods: A cross sectional study of 160 MRI brain images was performed in patients with the main complaint of seizure within one-year period. The percentage distribution of abnormalities was calculated separately for pediatric and adult groups with Excel software.

Results: The total diagnostic yield of abnormal cases ranged from 53% to 55%. In pediatric group major abnormalities found were hippocampal sclerosis 4 (21%) 'T2 hyperintense foci in various distributions' 4 (21%), and cortical atrophy 4 (21%) where as major abnormalities found in adults were space occupying lesions 19 (27%), ischemia/ infarcts 11 (16.2%), granulomatous lesions 8 (11%).

Conclusions: Lesions that are better detected in MRI include hippocampal sclerosis and T2 hyperintensities that form the bulk of abnormalities in the pediatric category. Majority of abnormalities in the adult category like space occupying lesions can be easily picked up by CT whereas refractory seizure, cases with EEG findings suggesting TLE, suspected stroke should preferably undergo MRI brain imaging as it is much more sensitive in detecting these pathological substrates.v

Keywords: epilepsy, hippocampal sclerosis, mesial temporal sclerosis, neuroimaging, temporal lobe epilepsy

INTRODUCTION

Seizure is a common neurological disorder. Seizure can occur due to various pathological causes or be idiopathic. The purpose of a diagnostic evaluation of a patient with seizure is to provide evidence that helps confirm or refute the diagnosis of epilepsy and to identify the cause of epilepsy and/or to classify the epileptic syndrome. Neuroimaging by Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) are used to detect and characterize structural brain abnormalities. CT is commonly used in patients presenting with new-onset seizure especially in emergency situations and can exclude acute neurologic problems that require urgent intervention. The mainstay of elective neuroimaging modality is MRI as it is more sensitive than CT for most epileptogenic lesions.[1]

Studies related to neuroimaging for seizure are limited in Nepal. Available studies mainly deal with findings in CT imaging, as this has been widely available for a longer period of time in Nepal. This study quantifies and evaluates imaging findings of 160 cases in MRI brain in seizure patients and discusses the advantages of MRI over CT.

Correspondence: Dr. Kritanjali Koirala, Lazimpat, DIRC MRI, Lazimpat, Kathmandu, Nepal. Email: kritamjali_koirala@hotmail.com, Phone: 9851020554.

The objective of the study is to study the total diagnostic yield of MRI in seizure patients and distribution/ types of neuroimaging finding in pediatric and adult groups as evidenced by MRI.

METHODS

A cross sectional study was carried out in Diagnostic Imaging and Research Center from July 2008 to June 2009. All patients diagnosed as having seizure by physicians and sent for evaluation of brain MRI in a private diagnostic center within this one year period was included in the study. Total of 160 cases were identified. The MRI brain images of these cases were evaluated for this study. The cases were evaluated separately for pediatric and adult groups with a rationale that causes for seizure and/ or percent distributions of abnormalities were different in the two age groups. No case of neonate seizure or febrile seizure was included.

MRI brain examinations were performed on a 0.2 Tesla whole body imager scanner (GE Medical Systems, US). Special seizure protocol was used for the imaging and is as follows:

All MRI studies included T2-weighted and T1 weighted, FLAIR and Diffusion weighted axial scans. T1 weighted sagittal scans, T2 weighted coronal and T2 thin coronal oblique scans.

T2 weighted coronal oblique scan was performed in a coronal oblique plane perpendicular to the long axis of the hippocampus without interslice gap and a thinner section of 4 mm. This sequence is important to assess hippocampal region in temporal lobe epilepsy.

Only patients with suspected SOL (tumor, metastasis) or inflammatory lesions received IV contrast. Omniscan I/V were administered 10ml to 20ml in adults depending on the weight whereas the pediatric dosage was 0.2ml/ kg body weight. All patients were screened for renal function prior to contrast administration.

All the images were reviewed in the PC. The reports were reviewed for consistency of findings. The cases were divided into pediatric group that comprised children up to and including 16 years old and the rest were categorized as adults. Distribution of abnormalities for the pediatric and the adult category were separate and calculated using Excel program.

RESULTS

There were a total of 160 brain MRI cases. The age range of patients was between 1 to 82 years. Total of 36(22.5%) cases comprised pediatric brain images and 124(77.5%) cases were adult brain images.

In the pediatric group total of 19(53%) cases were reported as abnormal. Among the major abnormalities noted were hippocampal sclerosis 4(21%), 'T2 hyperintense foci in various distributions' 4(21%), cortical atrophy 4(21%), ring enhancing lesions/ lesions with scolex/ focal small calcifications 3(15.7%) (Table 1).

Table 1. Distribution of abnormal neuroimaging findings in pediatric group.

Pediatric MRI findings	Number(%)
Hippocampal sclerosis	4 (21%)
T2 hyperintense foci in various distributions	4 (21%)
Cortical atrophy	4 (21%)
Ring enhancing lesions/ lesions with scolex/ focal small calcifications	3 (15.7%)
Space occupying lesions	2 (10.5%)
Tuberous sclerosis	1 (5.2%)
Suspected hydrocephalus	1 (5.2%)
Total	19 (100%)

Table 2. Abnormal T2 hyper intensities in various distributions in pediatric group.

Cases 1: Ill-defined foci of T2 hyper intensities in the sub cortical white matter regions predominantly in the frontal lobe, more on the left side- suggestive of? Leukodystrophy ? Significance.
Cases 2: Localized patchy areas of hyper intensity on T2W and FLAIR in the B/L frontal periventricular white matter. Possibility of focal demyelination/or incomplete myelination. D/D patchy infarcts. ? Cause.
Cases 3: T2/FLAIR hyper intensity in the sub cortical white matter of left frontal pole of temporal lobe and in the gray-white matter junction of frontal lobe bilaterally- probably trauma induced edema since the child has been symptomatic after the trauma. Differential possibility could be demyelinating disease, ADEM, viral encephalitis. In view of history of ataxia, another differential could be childhood ataxia with diffuse central nervous system hypomyelination (vanishing white matter disease) Please correlate clinically. Correlation with CSF finding recommended.

Among the four cases grouped in hippocampal sclerosis, two were unilateral cases and two were bilateral. Within the granulomatous lesions one case of calcific focus reported as calcified granuloma was also included as it was a known case of neurocysticercosis. No other cases of calcifications were found in the pediatric group.

Abnormal studies comprised 68(55 %) in the adult group. Major abnormalities seen were: space occupying lesions 19(27%), ischemia/ infarcts 11(16.2%), granulomas 8(11%), white matter hyper intensities 7(10%). Table No. 3 summarizes the distribution and findings.

Table 3. Distribution of abnormal neuroimaging findings in adult group.

Adult MRI brain findings	Number (%)
Space occupying lesions	19 (27%)
Ischemia/ infarction	11 (16.2%)
Granuloma	8 (11%)
White matter hyperintensities	7 (10%)
Cerebral atrophy with white matter hyperintensities	6 (8.9%)
Cerebral atrophy	4 (5.9%)
Hippocampal sclerosis	4 (5.9%)
Encephalomalacia	2(2.9%)
Calcification	2(2.9%)
Others (includes postop cases and trauma)	5(7.5%)
Total	68(100%)

DISCUSSION

The diagnostic yield of the MRI detected abnormality in this study ranged from 53% to 55%. This is comparable to various published studies on diagnostic yield of MRI detected abnormalities.[2-4] In a study by Weishmann where 677 patients from an epilepsy clinic had neuroimaging, 51% had an abnormal scan in MRI.[2] An earlier study by Li et al. also found similar findings.[3]

Hippocampal sclerosis is one of the major category of abnormality (21%) among the pediatric group, followed by 'T2 hyperintensities' and cortical atrophy. In this study the incidence of hippocampal sclerosis in pediatric group is high. Misra S et al. in their study in Nepal did not find hippocampal sclerosis in 31 cases of seizure evaluated with MRI.[4] Other studies in epilepsy clinics have also found that standard MRI tends to miss cases of HS, if tailored protocol are not followed.[2,3] A tailored protocol is employed for hippocampal imaging routinely for all seizure cases in the center where this study is carried out. This could in part explain the high rate of detection of HS in this study.

Hippocampal sclerosis (HS) is a finding related to temproral lobe epilepsy and is common in children with severe TLE or refractory TLE.[5] Histopathologically, HS is characterized by neuron loss and gliosis. HS is diagnosed in MRI by increased signal in hippocampus in T2 and FLAIR image with or without volume loss/atrophy.

Hippocampal sclerosis may be unilateral or bilateral. In this study among the four cases detected 2 cases were unilateral and 2 were bilateral. The finding of bilateral HS appears to correlate with poor prognosis for seizure control as evidenced by Mohamed et al. where tendency for lower seizure-free outcome was observed in children and adults up to 20 yrs of age with bilateral HS on MRI.[6]

Furthermore studies have shown that when HS is identified in MRI and EEG also shows epileptic discharges from the same area, surgery may be considered as the operative outcome is good.[7,8] Visual MRI allows detection of almost 90% of HS cases and hence is recommended in temporal lobe epilepsy evaluation specially if it is refractory.[9]

'T2 hyperintensities in various distributions' is another large category (21%) of abnormalities found in this study. T2 hyperintensities are a non - specific imaging finding. They may be seen in a variety of conditions: postictal, demyelination, desmyelination, infarct, edema, gliosis. Follow up is required as specific recognizable patterns may emerge. Clinical course and laboratory data may assist in narrowing the differential diagnosis. It may also assist in determining stable condition like insult related gliosis/encephalomalacia.

T2 hyperintensities that are punctuate and subtle are difficult to detect in CT. Mishra et al. reports 4 cases of normal CT having abnormal MRI in which the abnormalities included 2 cases of ADEM, one case of AVM and one case of infarct.[4] The cases of infarct and ADEM are T2 hyperintensities in MR imaging. Definite diagnosis of ADEM or infarct is derived by clinical correlation rather than MRI diagnosis per se.

Cerebral atrophy is another major finding (21%) and is a known cause of seizure in pediatric age group. Other authors have reported incidence of atrophy in the range of 10% to 37.5% in pediatric seizure cases among Indian sub continent children,[4,10-12] as well as in children among the western hemisphere (10% to 43%).[13-15] Birth asphyxia and various prenatal/ natal/ post natal insults to the brain can cause atrophy in children.

Granuloma represents only 8.3% of cases and the incidence appears to be lower than most studies in pediatric age group. Ring/Disc enhancing lesions were the commonest finding (up to 40%) among Indian sub continent children reported by Indian authors.[4,10,11]

This study did not come across cases of cerebral dysgenesis or malformations in pediatric imaging. A single case of known tuberous sclerosis was imaged.

Among the major abnormalities detected, space occupying lesion (SOL) was found to be the predominant cause for seizure in adults 27%, followed by ischemic lesions/ infarcts 16.2% and then suspected granulomatous lesions 11%. Although neurocysticercosis is supposed to be the number one cause for seizure in adults in Nepal it was not found so in this study and granulomatous lesions rank third in this study.[16]

If the SOL which comprise other suspected tumors/ metastasis/abscess is grouped with granulomatous lesions which are in effect SOL, this group reaches about

38% and represents the major cause for adult seizure. This has important implications in terms of neuroimaging as the major cause for seizure in adults appears to be structural lesions that can be easily picked up by CT.

Ischemia/infarction (16%) comprised another major abnormality in adults. Cerebral infarction can cause adult seizures.[17] Again Infarction in early stage or evolving cases is best diagnosed in MRI by Diffusion weighted or FLAIR imaging.[18]

In adults 'white matter abnormalities' were found in 10% of seizure cases. Dual pathology of non-specific white matter abnormalities and cerebral atrophy was found in 8.9% cases. Cerebral atrophy means loss of neurons and the connections between them. It is a common feature of many of the diseases that affect the brain and include stroke and traumatic brain injury, alcoholism, Alzheimer's disease, Pick's disease, and fronto-temporal dementia,cerebral palsy, Huntington's disease, leukodystrophies, mitochondrial encephalomyopathies, multiple sclerosis, infectious diseases, such as encephalitis, neurosyphilis, and AIDS. Many of these disorders are associated with seizure disorder clinically and T2 non-specific white matter abnormalities in MRI.[19]

Since the cause for non-specific white matter abnormalities with or without atrophy is numerous clinical correlations is important to use the imaging findings for patient management purposes.

Hippocampal sclerosis also appears as an important finding in the adults and constitutes about 5.9% of the detected abnormalities. As in children HS is the most common lesion found in adults with temporal lobe epilepsy that are pharmacoresistant.[20, 21]

Although the total diagnostic yield of abnormalities found in pediatric and adult population is similar (53% and 55% respectively) there is major variation in types of the abnormalities. The occurrence of abnormalities that caused seizure due to space occupying lesions are different in adults (27%) versus pediatric groups (10.5%). Presumed granulomatous lesions in the two groups are only marginally different with (11.2%) lesions found in adults and (15.7%) in children. The major difference seen is in the category of ischemia/ infarction that ranked second highest among the abnormalities in adult seizure cases (16.2%) but is not seen in the pediatric group. The substantial difference is also seen in cases of hippocampal sclerosis in adults (5.9%) compared to children (21%).

Various studies have found that MRI detects lesions that CT does not, such as hippocampal sclerosis, cortical dysplasia, vascular malformations, and some tumours like low grade glial tumors that cause seizure.[22,23] The present study found a high incidence of HS in pediatric group that may be attributable to MRI. Non - specific 'T2 hyperintensities' abnormalities are another set of lesions that may not be detected by CT.[4] If these two types of abnormalities are grouped in this study the total abnormality detected by MR imaging reaches 42% in pediatric category and 15.9% in adult category. Ischemia/infarction seen in the adult group is also diagnosed earlier and more reliably by MRI.[18] Rest of the lesions seen in both the categories can be detected by CT.

CONCLUSIONS

MRI is the modality of choice for brain imaging however it is costly. Clinicians therefore need to decide the modality for brain imaging. In pediatric population, adults with refractory seizure/ TLE and stroke should preferably undergo MRI evaluation since it is much more sensitive in detecting pathological substrates that give rise to seizure in this subgroup. MRI also has the potential to be tailored to an individual's need when the patient's clinical and electrophysiological data suggest temporal lobe epilepsy conditions like specific imaging for hippocampal sclerosis or Diffusion weighted imaging to detect infarctions. Additionally in pediatric subgroup MRI is also recommended, as it is a radiation free modality. In adult cases of seizure however CT may be advised as a primary modality since structural lesions like SOL and granulomas that constitute bulk of abnormality in this group may be adequately done so by CT while MRI can be selectively used for suspected stroke related seizures or refractory cases where CT is essentially normal.

REFERENCES

1. Recommendations for neuroimaging of patients with epilepsy Commission on Neuroimaging of the International League Against Epilepsy. Epilepsia. 1997 Nov;38(11):1255-6.
2. Wieshmann UC. Clinical application of neuroimaging in epilepsy. J Neurol Neurosurg Psychiatry. 2003 Apr;74(4):466-70.
3. Li LM, Fish DR, Sisodiya SM, Shorvon SD, Alsanjari N, Stevens JM. High resolution magnetic resonance imaging in adults with partial or secondary generalised epilepsy attending a tertiary referral unit. J Neurol Neurosurg Psychiatry. 1995 Oct;59(4):384-7.
4. Misra S, Das BK, Srivastava AK Neuroimaging Study in Children with Seizures. Journal of Nepal Paediatric Society. 2007;27(1):13-6.
5. Ng YT, McGregor AL, Duane DC, Jahnke HK, Bird CR, Wheless JW. Childhood mesial temporal sclerosis. J Child Neurol. 2006 Jun;21(6):512-7.

6. Mohamed A, Wyllie E, Ruggieri P, Kotagal P, Babb T, Hilbig A, et al. Temporal lobe epilepsy due to hippocampal sclerosis in pediatric candidates for epilepsy surgery. Neurology. 2001 Jun 26;56(12):1643-9.
7. Jackson GD. Visual analysis in mesial temporal sclerosis. In: Cascino GD, Jack CR Jr, editors. Neuroimaging in epilepsy: principles and practice. Boston: Butterworth-Heinemann; 1996. p. 73-110.
8. Cascino GD, Jack CR Jr, Parisi JE, Sharbrough FW, Hirschorn KA, Meyer FB, et al. Magnetic resonance imaging-based volume studies in temporal lobe epilepsy: pathological correlations. Ann Neurol. 1991 Jul;30(1):31-6.
9. Jack CR Jr, Sharbrough FW, Cascino GD, Hirschorn KA, O'Brien PC, Marsh WR. Magnetic resonance image-based hippocampal volumetry: correlation with outcome after temporal lobectomy. Ann Neurol. 1992 Feb;31(2):138-46.
10. Kumar R, Navjivan S, Kohli N, Sharma B. Clinical correlates of CT abnormality in generalized childhood epilepsy in India. J Trop Pediatr. 1997 Aug;43(4):199-203.
11. Wadia RS, Makhale CN, Kelkar AV, Grant KB. Focal epilepsy in India with special reference to lesions showing ring or disc-like enhancement on contrast computed tomography. J Neurol Neurosurg Psychiatry. 1987 Oct;50(10):1298-301.
12. Kapoor M, Talukdar B, Chowdhury V, Puri V, Rath B. Intracranial structural lesions in young epileptics: a computed tomographic study. Indian Pediatr. 1998 Jun;35(6):537-41.
13. Bachman DS, Hodges FJ, Freeman JM. Computerized axial tomography in chronic seizure disorders of childhood. Pediatrics. 1976 Dec;58(6):828-32.
14. Young AC, Costanzi JB, Mohr PD, Forbes WS. Is routine computerised axial tomography in epilepsy worth while? Lancet. 1982 Dec 25;2(8313):1446-7.
15. Shinnar S, O'Dell C, Mitnick R, Berg AT, Moshe SL. Neuroimaging abnormalities in children with an apparent first unprovoked seizure. Epilepsy Res. 2001 Mar;43(3):261-9.
16. Pant B, Lin N. An epidemiological study of neurocysticercosis in Nepal. In: Proceeding of the Society of Internal Medicine of Nepal. Kathmandu: Society of internal medicine Nepal; 2002;17:55-8.
17. Ramirez-Lassepas M, Cipolle RJ, Morillo LR, Gumnit RJ. Value of computed tomographic scan in the evaluation of adult patients after their first seizure. Ann Neurol. 1984 Jun;15(6):536-43.
18. James DE. Stroke CT and MR Imaging of the Whole Body. p. 246-284.
19. Cerebral Atrophy Information Page. National institute of neurological disorders and stroke.
20. Tarkka R, Pääkkö E, Pyhtinen J, Uhari M, Rantala H. Febrile seizures and mesial temporal sclerosis. Neurology. 2003 Jan;60(2):215–8. Available from: URL: www.ninds.nih.gov/disorders/cerebral_atrophy/ cerebral_atrophy.htm NINDS
21. Wehner T, Lüders H. Role of neuroimaging in the presurgical evaluation of epilepsy. J Clin Neurol. 2008 Mar;4(1):1-16.
22. King MA, Newton MR, Jackson GD, Fitt GJ, Mitchell LA, Silvapulle MJ, et al. Epileptology of the first-seizure presentation: a clinical, electroencephalographic, and magnetic resonance imaging study of 300 consecutive patients. Lancet. 1998 Sep 26;352(9133):1007-11.
23. Scottish Intercollegiate Guidelines Network. Diagnosis and management of epilepsy in adults. Edinburgh: Scottish Intercollegiate Guidelines Network; 2003.