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Role of Mri In The Diagnosis Of Epilepsy In Children

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Abstract

Background: Epilepsy is one of the most common neurological disorders in the world, with 85% of the 50 million with the disease living in developing countries Thus, accurate diagnostic classification is essential to establishment of the appropriate treatment plane. The aim of this work to evaluate the role of new techniques of magnetic resonance imaging in the evaluation of causes of epilepsy on 40 cases in children age group. Methods: This study was conducted on 40 children with epilepsy. The study. Patients were referred to the Radiodiagnosis Department from: the Pediatric Neurology Outpatient Clinic in Benha and Zagazig University Hospitals. Results: The patient group included a total of 40 patients, 17 (42.5%) females and 23 (57.5%) males with age ranging from 1 to 15 years (mean 8.93 ± 4.01 years). Demographic data of our patient and control groups. According to clinical type of seizures provisionally diagnosed by referral, complex partial seizures are the most common (50%) followed by partial seizures with secondary generalization (27.5%) and simple partial seizures(20%). The duration of the disease illness at time of performing the MRI studies varied from 1 year to13 years (Mean 6.2 ± 3.17 years). The seizures frequency was ranging from one to ten attacks per month (Mean 4.19± 2.52 attacks per month). Right temporal lobe epilepsy were found in 10 (25%) patients, while Left temporal lobe epilepsy were found in 7 (17.5%) patient, Bilateral temporal lobe epilepsy was found in 9 (22.5%) patients, Right frontal lobe epilepsy were found in 6 (15%) patients, Left frontal lobe epilepsy were found in 3 (7.5%) patient, Bilateral frontal lobe epilepsy were found in 5 (12.5%) patients. Cortical dysplasia had been found in 9 (22.5%) patients, Polymicrogyra had been found in 4 (10%) patients; Sturge Weber disease had been found in 3 (7.5%) patients; Gliosis from acquired insult had been found in 11 (27.5%) patients, Hippocampal sclerosis had been found in 3 (7.5%) patients; Brain tumors had been found in 10 (25%) patients. Cortical dysplasia: focal area of cortical thickening displayed hypointense to isointense to gray matter in T1, hypreintense in T2 and FLAIR, no significant post contrast enhancement. Polymicrogyra: thickened gyri and shallow sulci displayed isointense signal to gray matter in T1, T2 and FLAIR. Sturge Weber syndrome: localized prominent leptomeningeal enhancement and ipsilateral choroidal enlargement. Gliosis: focal area of abnormal signal displayed isointense signal at T1, high signal at T2 and FLAIR, no significant post contrast enhancement. Volume loss of affected lobe and evacodilalation of related ventricle had been observed. Hippocampal sclerosis: Decreased size and abnormal signal of hippocampus with prominent ipsilateral temporal horn. It displayed high signal on T2 and FLAIR. Conclusion: Multimodality neuroimaging with MRI imaging, diffusion tensor imaging, and magnetic source imaging plays an essential role in noninvasively localizing epileptogenic foci for possible surgical resection.

Keywords: MRI, Diagnosis, Epilepsy, Children.

1. Introduction

Epilepsy is one of the most prevalent neurological disorders that can be effectively prevented and treated at an affordable cost. It is the most common serious brain disorder worldwide with no age, racial, social class, neither national nor geographic boundaries. There are over 50 million sufferers, 85% of whom live in developing countries. The estimated proportion of the general population with active epilepsy (i.e. continuing seizures or the need for treatment) at a given time is between 4 to 10 per 1,000 people. However, some studies in developing countries suggest that the proportion is between 6 to 10 per 1,000. At least 50% of cases begin at childhood or adolescence. 70% to 80% of people with epilepsy could lead normal lives if properly treated [1].

Current antiepileptic drugs can control seizures in only 80% of individuals with epilepsy. Surgical treatment is an effective therapeutic option for individuals who have refractory epilepsy, especially those with well localized temporal lobe epilepsy (TLE). The success of surgical treatment in controlling an individual's seizure depends largely on the accurate localization, and subsequent resection of the epileptogenic area [2].

The results from an individual's clinical and neurophysiological examinations that are both interpretable and congruent were regarded as the "gold standard" for localizing the epileptogenic area. This usually involves a combination of video monitoring and EEG recording, which is generally performed in a hospital setting often for a prolonged period of time and after reduction of medication. Furthermore, in some patients with no clear localization or lateralization of the epileptogenic area, an invasive neurophysiological approach is required for further clarification. This is often the case in patients who are either diagnosed to have bilateral TLE or who have shown conflicting clinical and EEG-localizing features [3].

Diffusion-tensor magnetic resonance (MR) imaging (DTI) and fiber tractography (FT) are the new techniques in the field of neuroimaging which

demonstrate the orientation and integrity of white matter fibers [4].

DTI is an emerging MRI technique in the field of neuroimaging which uses anisotropic diffusion to show the integrity of the white matter axonal pathway. Fiber tractography utilizes the data collected by DTI and reconstructs the three-dimensional (3D) image of the neural tracts. DTI has been extensively studied for its application in white matter pathologies; however, it has a limited role in grey matter pathologies. Developmental central nervous system (CNS) diseases, both congenital and postnatal, can be a spotlighted field of DTI due to the potential for generating a fiber pathway and aberrant connections in the case of a blockage of normal white matter formation. [5]

The aim of this work to evaluate the role of new techniques of magnetic resonance imaging in the evaluation of causes of epilepsy on 40 cases in children age group.

2. Patients and Methods

The study population included two groups: patient group (40 children) and control group (20 children). The study was conducted at Radio diagnosis Department of Benha and Zagazig University Hospital over a period of 24 months.

Patient group:

The patient group included a total of 50 patients, 20 females and 30 males with age ranging from 1 to 1٤ years (mean 9.26 ± 3.9 years). Patients were referred to the Radiodiagnosis Department from: the Pediatrics Neurology Outpatient Clinic in Zagazig University Hospital. The duration of the disease illness at time of performing the MRI studies varied from 1 year to13 years (Mean 6.5 ± 3.59 years). The seizure frequency was ranging from one to nine attacks per month (Mean 3.62± 2.18 attacks).

Inclusion criteria

- Intractable epilepsy
- Patient age ranges from 1 to15 years
- Patient complains of partial seizures with or without secondary generalization
- EEG and/or MRI detection of focal epileptic abnormality.

Exclusion criteria

- Nonepileptic events simulating epilepsy
- Patients with good response to medical treatment.
- Pseudointractability: no response to medications for a specific, correctable reason (other than because of a difficult epilepsy) such as incorrect medication , non-reasonable (possibly maximal) doses and insufficient treatment period
- Patient less than 1 years and more than 14 years.
- Patient with generalized seizures.
- Generalized epileptogenic activity on EEG or diffuse brain abnormality on MRI.
- Contraindications to magnetic resonance imaging (MRI) (e.g. cochlear implants, metallic foreign bodies, cardiac pacemaker, ferromagnetic aneurysm clips).
- The parents declined permission for data to be used for research.

Both patient and control groups were subjected to the following:

1. Full history taking (from the children or their parents).
2. Clinical evaluation (by pediatric neurologist) of epilepsy, doses and types of antiepileptic drugs to exclude peudointractability.
3. Routine laboratory investigations: CBC, ESR, Electrolyte levels, including sodium, potassium, magnesium, and calcium concentrations, blood glucose level, liver and kidney functions.
4. Surface EEG: EEG was done at Pediatrics Department of Zagazig University Hospital using 18 channels digital EEG Nicolet Biomed alliance works. Electrodes were arranged according to the international 10-20 system of surface electrodes placement using mono and bipolar montages. Hyperventilation for 3 minutes together with intermittent photic stimulation was used as provocative methods for all patients and controls. EEG was carried out under normal standard conditions (The patient was lying supine completely relaxed in a quiet room). The EEG tracing were analysed carefully as regarding the background activity, presence of any generalized or focal abnormalities.
5. MR imaging and MR spectroscopy with 1.5 Tesla superconducting MR imager (Achieva, Philips Medical System)

MR Imaging Spectroscopy Techniques:

1. Verbal consents were taken from all the parents as well as detailed explanation of the study techniques and their values were conducted in full details to all parents before the examination start.
2. Children under 7 years of age were anesthetized prior to the examination for avoiding motion artifact.
3. Parents of children who required anesthesia were told to keep them fasting for 3-4 hours prior to the MRS examination
4. MR and MRS were done using 1.5 Tesla superconducting MR imager (Achieva, Philips Medical System)
5. The examination was done with the child in the supine position using the standard head coil.
6. Contrast agent was given to some MR positive cases when needed. The contrast media used was Gd-DTPA (Gadolinium). The dose: IV 0.1-0.2mmol/kg body weight.

The conventional MR Sequences were done as the following:

1. Sagittal T1WI as localizer (TE 8/TR 500).
2. Axial T1WI (TR148-597/TE2-15).
3. Axial T2WI (TR4400-4800/TE110).
4. Axial Fluid attenuation inversion recovery (FLAIR) (TR6000/TE120-TI2000). For cases of TLE (diagnosed by history, clinical examination

and EEG) , axial FLAIR oblique thin cuts 3 mm were taken parallel to the axis of temporal horn.

5. Coronal FLAIR (TR6000/TE120-TI2000). For cases of TLE, coronal FLAIR oblique thin cuts 3 mm are taken perpendicular to the axis of temporal horn.
6. Post contrast T1 axial, coronal and sagittal spine echo sequences :Te=8m/s TR=500m/s were taken in some MR positive cases when needed.

The previous sequences were done with slice section 5 mm thickness with 1mm gap and field of view (FOV) 230 mm.

Statistical Analysis:

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data, the following tests were used to test differences for significance; differences between frequencies (qualitative variables) and percentages in groups. Data were collected and submitted to statistical analysis. The following statistical tests and parameters were used.

3. Results

The patient group included a total of 40 patients, 17 (42.5%) females and 23 (57.5%) males with age ranging from 1 to 14 years (mean 8.93 ± 4.01 years). Demographic data of our patient and control groups are resting in table (1).

According to clinical type of seizures provisionally diagnosed by referral, Table (2) and table (3) shows that complex partial seizures are the most common (50%) followed by partial seizures with secondary generalization (27.5%) and simple partial seizures(20%). The duration of the disease illness at time of performing the MRI studies varied from 1 year to13 years (Mean 6.2 ± 3.17 years). The seizures frequency was ranging from one to ten attacks per month (Mean 4.19± 2.52 attacks per month).

All cases was diagnosed clinically and by EEG before referral, and according to MRI finding, patients were devided to MRI positive group 22 patients (55%) and MRI negative group (apparently normal MRI) 18 patients (45%) table (4)

Table (1) Age and Sex Distribution among Patient and Control Groups.

Sex	**Male**	**Count**	23
		%	57.5%
	Female	**Count**	17
		%	42.5%
Age		**Mean**	8.93
		SD	± 4.01

Table (2) Type of Seizures Distribution in Patient Group.

Type of seizures	N	%
Simple partial seizures	8	20%
Complex partial seizures	21	52.5%
Partial seizures with secondary generalization	11	27.5%
Total	40	100%

Table (3) Frequency of Seizures Distribution in Patient Group.

	Duration of epilepsy (years)	Number of seizures (month)
Mean	6.2	4.19
Median	5	4
Std. Deviation	3.17	2.52
Minimum	1	1
Maximum	12	10

Table (4) Classification of patient according to MRI findings.

Type of seizures	N	%	Sensitivity	Positive Predictive Value
MRI positive group	22	55%	55%	5.76 %
MRI negative group	18	45%	(38.49% to 70.74% with 95% CI)	

According to Etiology of epileptic focus according to EEG In table (5) **Right temporal lobe epilepsy** were found in 10 (25%) patients , while **Left temporal lobe epilepsy** were found in 7 (17.5%) patient , **Bilateral temporal lobe epilepsy** was found in 9 (22.5%) patients, **Right frontal lobe epilepsy** were found in 6 (15%) patients , **Left frontal lobe epilepsy** were found in 3 (7.5%) patient , **Bilateral frontal lobe epilepsy** were found in 5 (12.5%) patients, According to Pathological findings by MRI. In table (6) Cortical **dysplasia** had been found in 9 (22.5%) patients, **Polymicrogyra** had been found in 4 (10%) patients;. **Sturge Weber disease** had been found in 3 (7.5%) patients; **Gliosis from acquired insult** had been found in 11 (27.5%) patients, **Hippocampal sclerosis** had been found in 3 (7.5%) patients; **Brain tumors** had been found in 10 (25%) patients,

Table (7) shows MR findings in different causes of epilepsy as following . **Cortical dysplasia**: focal area of cortical thickening displayed hypointense to isointense to gray matter in T1, hypreintense in T2 and FLAIR, no significant post contrast enhancement. **Polymicrogyra:** thickened gyri and shallow sulci displayed isointense signal to gray matter in T1, T2 and FLAIR **Sturge Weber syndrome**: localized prominent leptomeningeal enhancement and ipsilateral choroidal enlargement. **Gliosis**: focal area of abnormal signal displayed isointense signal at T1, high signal at T2 and FLAIR, no significant post contrast enhancement. Volume loss of affected lobe and evacodilalation of related ventricle had been observed. **Hippocampal sclerosis**: Decreased size and abnormal signal of hippocampus with prominent ipsilateral temporal horn. It displayed high signal on T2 and FLAIR. **Brain Tumors:** *Fibrillay astrocytoma displayed isointense at T1, hyperintense at T2 and FLAIR. No significant post contrast enhancement. *Pilocystic astrocytoma displayed low to isointense at T1, hyperintense at T2 and FLAIR with enhanced mural nodule. *DNET (Dysembryoplastic neuroepithelial tumour) displayed low to isointense at T1, hypreintense at T2 (bubbly appearance) and hypreintense at FLAIR. No significant post contrast enhancement.

Table (5) Etiology of epileptic focus according to EEG

Etiology	N	%
Right temporal epilepsy	10	25
Left temporal epilepsy	7	17.5
Bilateral temporal epilepsy	9	22.5
Right frontal epilepsy	6	15
Left frontal epilepsy	3	7.5
Bilateral frontal epilepsy	5	12.5
Total	40	100

Table (6) Pathological findings by MRI

Pathological finding by MRI	N	%
Cortical dysplasia	9	22.5
Polymicrogyra	4	10
Struge weber disease	3	7.5
Gliosis	11	27.5
Hippocampal Sclerosis	3	7.5
Brain Tumors	10	25
Total	40	100

Table (7) MR Findings in Different Causes of Epilepsy.

	T1WI	T2WI	FLAIR	Another Findings
Cortical dysplasia	hypointense to isointense to gray matter	Hypreintense	Hypreintense	Cortical thickening
Polymicrogyra	isointense to gray matter	isointense to gray matter	isointense to gray matter	Multiple Small thicken gyri
Struge Weber disease	-	-	-	Leptomeningeal enhancement Chroidal angioma
Gliosis from acquired insult	isointense	Hypreintense	Hypreintense	Evacodilatation of related ventricles.
Hippocampal Sclerosis	hypointense to isointense to gray matter	Hypreintense	Hypreintense	*Decreased size *Prominent ipsilateral temporal horn
Brain tumors	hypointense to isointense to gray matter	Hypreintense	Hypreintense	---

4. Discussion

All cases was diagnosed clinically and by EEG before referral, and according to MRI finding, patients were devided to MRI positive group 22 patients (55%) and MRI negative group (apparently normal MRI) 18 patients (45%)

The patient group included a total of 40 patients, 17 (42.5%) females and 23 (57.5%) males with age ranging from 1 to 15 years (mean 8.93 ± 4.01 years). Demographic data of our patient and control groups.

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Perfusion MRI can most easily be applied to interictal imaging. Interictal hypometabolism has been used to lateralize seizure foci in TLE. In one study of ASL MRI for presurgical lateralization, ASL was in good agreement with PET-FDG [(1)]. A similar evaluation using DSC MRI has also been reported [(6)]. Ictal imaging can most easily be performed in patients with frequent seizures.

Intractable pediatric epilepsy patients represent a challenging clinical population, although advances in MRI continue to improve diagnosis and treatment in these patients. Multimodality neuroimaging with MRI imaging, diffusion tensor imaging, and magnetic source imaging plays an essential role in noninvasively localizing epileptogenic foci for possible surgical resection.

5. Conclusion

Multimodality neuroimaging with MRI imaging, diffusion tensor imaging, and magnetic source imaging plays an essential role in noninvasively localizing epileptogenic foci for possible surgical resection.

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