

Role of Computed Tomography and Magnetic Resonance Imaging in Children, (age 1 day to 16 years old) with Recent Onset Seizure)

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Abstract

New-onset seizures represent the most common neurologic emergency of childhood, with approximately 44 per 1000 of children and adolescent in under developed countries (age 1 day to 16 years old) presenting for evaluation of a newly occurring seizure disorder. The study aim to find the role of computed tomography and/or magnetic resonance imaging in children with seizure. Cross sectional study will be conducting in AL-Hilla Teaching hospital from period 1st of November 2018 to 1st of July 2019, will be enrolling infants and children with new onset seizure (age 1 day to 16 years) to investigate brain imaging abnormalities in these patients by computed tomography and magnetic resonance imaging. The study enrolled 50 patients presented with first attack of epilepsy. The mean age of patient was 11 ± 4.2 years with range 1 day – 16 years. My study reveal kinds of abnormality that seen by images modalities, 16% of patients had congenital anomaly, 2% had gliosis, 4% genetic disorder, 2% had arteriovenous malformation, and 2% had brain tumor. MRI is the beneficial to evaluate the structural defect in brain that cause seizure and also give an idea to some extent need to surgical interference. While computed tomography is a good choice in emergency department. **Key words:** Magnetic Resonance Imaging; Computed Tomography; Diffusion Weight Image; Apparent diffusion coefficient.

Introduction:

Seizure is a sudden alteration in behavior, awareness, motor movement, body posture, and /or sensory or psychic perception from both physiological and non-physiological causes. Which may be paroxysmal and stereotyping (Mohammadi et al 2013).

Epilepsy is recurrent (more than two times), unprovoked cause by physiological abnormal brain electrical activity produce by idiopathic or brain pathology (Berg A et al 2013). Motor activity during seizure are divided to four categories, **Tonic** which mean increase tone or rigidity, **Atonic** which mean flaccidity or lack of movement during attack. **Clonic** mean rhythmic muscle

contraction and relaxation (Fahoum F et al 2013).

Myoclonic mean shock like contraction of muscle. Range of epilepsy incidence in children (41-187/100,000). Higher incidence is reported from developing countries in rural areas.

Incidence is highest in the 1st year of life and declines to the end of the 1st decade. Prevalence of epilepsy in children is “ranges from 3.2-5.5/1,000 in developed countries and 3.6-44/1,000 in underdeveloped countries”(Berg A et al 2013).

Prevalence is highest in rural areas. Incidence and prevalence of specific seizure types and epilepsy syndromes is less well documented. In population-based studies, there is a slight predominance of focal seizures compared with generalized seizures (Mohammadi et al 2013).

Etiology

1. Cerebrovascular events: infarction, hemorrhage (subarachnoid hemorrhage, subdural hemorrhage and Intraventricular Hemorrhage), arteriovenous malformation, venous thrombosis, Cavernous Hemangioma.
2. Hypoxic events: hypoxic ischemic encephalopathy, stroke.
3. Metabolic: hypoglycemia, Inborn error of metabolism.
4. Tumors: Low Grade astrocytoma, ganglioglioma and oligodendroglioma.
5. congenital malformations Lissencephaly, megalencephaly, Dandy walker malformation.
6. CNS trauma: acute trauma, previous trauma with tissue scar formation.
7. CNS infection: meningitis, encephalitis, abscess.
8. Toxins: drugs, poisons.
9. Mesiotemporal sclerosis
10. Phacomatosis like tuberous sclerosis
11. Idiopathic: which account for 50% of cases. (Berg A et al 2013).

When we identify the seizure type, the age of the onset, results of electroencephalogram (EEG) and additional information such family history and neurological findings, then we can predict the possible management protocol, underlying a etiology and prognosis (Esen Besli et al 2017).

MRI

Is the best method for evaluation of the brain "structure and function". functional MRI defined as specific region of brain activity can be assessed (Kimia AA et al 2012).

MRI epilepsy protocol T1WI

Is the best for cortical thickness, interference between white and grey matter. In addition to axial, sagittal T1WI view of the whole brain can detect any abnormality like midline congenital abnormalities ex. corpus callosum agenesis (Mohammadi et al 2013).

FLAIR

look very carefully for cortical and subcortical hyper intensities which can be very subtle. Since FLAIR may show false positive results due to artifacts, the abnormalities should be confirmed by T2WI (Kimia AA et al 2012).

T2WI

used for detection of hemoglobin breakdown as in post-traumatic events or for detection of calcification in tuberous sclerosis, cavernomas and gangliogliomas (Esen Besli et al 2017). The routine MRI brain examination are sagittal and axial T1, axial T2 and coronal FLAIR sequences in patients up to 6 months it is important to increase TR to 6000ms on the T2 sequence to improve the difference between grey and white matter. Perfect resolution and improve contrast can be obtained by T1 weighted inversion recovery. Cortical dysplasia is not easy to be detected in pediatric epilepsy imaging. T1 weighted images are sensitive to detect the cortical change. Gliosis is response to tissue damage equivalent to brain scanning seen in T2, proton density and FLAIR as area of high signal (Esen Besli et al 2017).

Mesial temporal sclerosis (MTS):

Is a pattern of hippocampal neuronal loss consist of gliosis and atrophy of

unknown cause but there is a relationship between MTS and prolong febrile seizure and difficult labor ,the MTS cause cognitive impairment in children “intelligence , language and achievement but not affect The performance in other selected activities “attention, concentration” In 18 % of cases, another developmental abnormality detected mostly focal cortical dysplasia(dualpathology) (Mohammadi et al 2013).

MRI finding in mesial temporal sclerosis(MTS)

1. decrease hippocampal volume(atrophy)
 2. increase T2 signal
 3. loss of internal architecture
- Comparing right and left hippocampus size and signal intensity is easiest way. (Kimia AA et al 2012).

Indirect signs of MTS)

1. Enlargement temporal horn of lateral ventricle.
2. Atrophy of ipsilateral fornix and mammillary body
3. Dilated temporal horn and temporal lobe atrophy.

Aim of study:

1. to assess the role of computed tomography and magnetic resonance imaging to detect and localized the underling pathology behind epilepsy.
2. To select the modality of radiological imaging either computed tomography or magnetic resonance imaging which is more beneficial to reach the diagnosis.

Method:

By this cross sectional study 50 patient with an age group from (1 day to 16)years old were studied in radiology unit of AL-Hilla Teaching hospital between 1November 2018 to 1 July 2019 with seizure, the MRI is decided by both physician or pediatrician and radiologist , cases of febrile convulsion were excluded.

Indication for imaging:

- 1-patient with focal neurological deficit.
- 2- patient with developmental regress.
- 3-patient with neurocutaneoussyndromes(phakomatosis) like tuberous sclerosis .
- 4-simple partial seizure.
- 5-refractory complex partial seizure not respond to treatment.
- 6-Infantile spasm or myoclonic seizure in first 12months of age .
- 7- persistent unclassifiable seizure .(29)

A complete history was collected from each patient age , sex , Mode of labor (normal or Caesarean section) , past medical history , vaccination , developmental history , age at seizure onset , family history , , treatment (drug type and its duration) , aura, type of seizure which confirmed by EEG in most cases. Complete examination was done by physician including clinical and neurological. Patients with seizure were examined using” MRI Phillips Gyroscan N.T 3000 Super conducting, 1.5 Tesla”, and CT Siemens system, 64 slice using automated tube if MRI not available. Brief explanation to the family about the examination way of patient and explain to them the procedure, sometimes child need anesthesia, so the parent have to know the benefit of anesthesia to their child .,I have to inform the parent about the bad noise that will be heard while being laying down in a narrow space and the communication will be via the intercom head coil is used.

MRI Technique examination :

Patient lay down on table with head support small wedge used to immobilize the head by placing them firmly between the head and sides of support .the head strap can be used for extra stabilization . Close the base, move the table toward the magnet switch on the light and center it to have good quality image.(29)Brain axial T1, axial T2 and sagittal T1 and T2, coronal and axial FLAIR. Axial DWI and ADC Image if needed. If abnormal lesion or signal detected, T1 axial and sagittal section with intravenous contrast injection “Gadolinium 0.1 -0.2 mmol /kg is given, and DWI image and plan

if needed
Statistical analysis :
 After collection of data then check for any error or inconsistency then it transferred into computerized data base in which Microsoft excel is used (a data base scheme)and analysis by statistical package of social sciences". "Parametric information was presented as mean+standard deviation (SD), frequencies and proportion. While Chi square were used alternatively to find the significance of comparison for frequencies and proportion. Level of significance (P value) less than 0.05 was thought of statistically important.

Result

The study enrolled 50 patients presented with first attack of epilepsy. The mean age of patients was 11 ± 4.2 years with range 1 day – 16 years. The patients divided in group with according to age of them. From 1 day to 30 day were 7 patients, from age group 1 month to 12 month 5 patients, from 1 year to 5 years 9 patients, in age group 6 to 11 years there were 14 patient and in age group 12-16 years were 15 patients. As shown in table 1. Sixty two percent of patients were male and 38% of them were female as in table 2.

Table 1: show age distribution.

| Age | No. | Percent |
|----------------------|-----|---------|
| 1 day-30 day | 7 | 14% |
| (1 month -12 months) | 5 | 10% |
| 1-5 years | 9 | 18% |
| 6-11 years | 14 | 28% |
| 12 -16 years | 15 | 30% |
| Total | 50 | |

Table 2: show gender distribution.

| Gender | No. | Percent |
|--------|-----|---------|
| Male | 31 | 62% |
| Female | 19 | 38% |
| Total | 50 | |

In table three reveals kinds of abnormality that seen by images modalities, 16% of patients had congenital anomaly, 2% had gliosis, 4% genetic disorder, 2% had arteriovenous malformation, and 2% had brain tumor .

Table 3: show type of abnormality seen in brain.

| Types of abnormality | | No. | Percent |
|----------------------|----------------------------|-----|---------|
| Imaging abnormality | Congenital anomaly | 8 | 16% |
| | Gliosis | 1 | 2% |
| | Phakomatosis | 2 | 4% |
| | arteriovenous malformation | 1 | 2% |
| | brain tumor | 1 | 2% |
| Total | | 13 | 26% |

Twenty six percent of patients were diagnosed by CT scan only, 40% were examined by MRI and 34% of patients were diagnosed by both types MRI and CT scan as in table 4.

Table 4: show types of images modalities

| Type of image | No. | Percent |
|---------------|-----|---------|
| CT scan | 13 | 26% |
| MRI | 20 | 40% |
| Both | 17 | 34% |

On other hand, patients presented many clinical manifestation of neurological types of seizure, 60% presented generalized tonic clonic, 24% appear generalized tonic seizure, 10% atonic seizure, 45 absence type of seizure and last one patient come with simple focal seizure, these shown in table 5. In addition, duration of attack also variables between patients, 68% of them < 5 minutes in duration while 23% of patients continue to 5-15 minutes and only 6 patients the attack duration more than 15 minutes as shown in table 6.

Table 5: show types of seizure.

| Types of seizure | No. | Percent |
|--------------------------|-----|---------|
| Generalized tonic-clonic | 30 | 60% |
| Generalized tonic | 12 | 24% |
| Atonic seizure | 5 | 10% |
| Absence | 2 | 4% |
| Simple focal | 1 | 2% |

Table 6: show duration of fit by patients.

| Duration of seizure | No. | % |
|---------------------|-----|-----|
| < 5 minutes | 34 | 68% |
| 5-15 minutes | 13 | 23% |
| 15 minutes | 3 | 6% |
| Total | 50 | |

Discussion

The study reveals prevalence of neurological images abnormality was 26% (13 patients), eight of patients had congenital anomaly, one had gliosis, two had genetic disorder, one had arteriovenous malformation and one had brain tumor. Many studies reported slightly higher rate neuroimaging abnormality than our study which range from 27% to 35% such as studies were did by Rassol et al 2011, Poudel et al 2013 and Mohammadi et al 2013.

In study by Muthuraja et al 2018, reveal prevalence of abnormality in image investigation was 33%. And most common type of abnormality were Ring enhancing lesion 45%, congenital diseases were 18%, one patients with tumor constitute 4% of his

study and two patients were had neuro degenerated diseases.

Twenty seven percent also recorded in Iran by Mohammadi et al 2013 study, with 10.4% of gliosis, dysmyelination 7%, 5.25 hemorrhage and 2% brain dysgenesis⁽¹⁶⁾.

Esen Besli et al 2017, reported the prevalence of neuroimaging abnormality was 24% and just 5% need urgent operation. Study by Shinnar et al 2011, found rate of abnormality at 21% when he followed 411 children with first a febrile seizure in prospective manner, and that they requiring surgical intervention near to 1%. One of the scientist he reported prevalence as low as 12% of neuroimaging abnormality (Kimia AA et al 2012).

Researches in Iran and Saudi Arabia found similar rate of neurological image abnormality in retrospective studies approximately 10%, with no clear difference between MRI and CT scan images that did for patient (Khodapanahandeh F et al 2006, Alawaneh H et al 2008).

On other hand study by Kalnin et al 2008, was showed abnormality in 31% of children, and the most common pathology was ventriculomegaly follow by gliosis, dysplasia and brain atrophy⁽²²⁾.

In present study, male represented 62% and female 38% and the mean age of patients was 11 ± 4.2 years with range 1 day – 16 years.

A study conducted by Muthuraja M et al 2018 was categorized patients in group of Infants 1 month to 1 year were eight patients, toddler hood 1 to 3 years were three patients, preschool children 3 to 6 years were five patients school age 6 to 10 years were three patients and adolescence 10 to 16 years were 46 patients, which is agreement with our study by appearance increase in patients with advance in age. And male constitute 55.1% and female 44.9% .

Where as in Esen Besli et al 2017 study 55% were male and 45% were female and the mean age 6.6 ± 5.3 years and range 1 month to 17 years, had two group above 24 month and below or equal 24 months⁽¹⁷⁾

Other result reveal neurological types of seizure, 60% presented with generalized tonic clonic, 24% appear generalized tonic seizure, 10% atonic seizure, 45 absence type of seizure and last one patient come with simple focal seizure.

More over, study conducted in Tehran demonstrated six types of seizure generalized tonic clonic 62%, generalized tonic 14%, a tonic seizure 12.5%, absence 3% focal complex 6% and simple focal 1% (Mohammadi et al 2013).

Another finding, the duration of attack also variables between patients, 68% of them < 5 minutes in duration while 23% of patients continue to 5-15 minutes and only 6 patients the attack duration more than 15 minutes. With agreement to these finding a study conducted by Esen Besli et al 2017 was

reported 67.1%, 31.2% and 1.7% respectively.

Twenty six percent of patients were diagnosed by CT scan only, 40% were examined by MRI and 34% of patients were diagnosed by both types MRI and CT scan. Only of seven patients that did both CT scan and MRI where reported normal by CT scan, where as two patients with both modalities accurately diagnosis by MRI.

The choices between two modalities depend up on availability of these image, physical examination and senior opinion. As more time the instrument out of work because of crowded and other mechanical defect(Leslie A et al 2018).

In emergency sitting CT scan is preferred from MRI, because CT scan technically easier than MRI, in addition most of CT scan not need sedation for child to do, beneficial when not available of anesthetic. Also CT scans beneficial to detect extent of intracrainal hemorrhage and cortical abnormality. Whilst one of pitfall in expose children to high ionizing radiation (Esen Besli et al 2017).

Although MRI need sedation in young children, still it preferred to CT scan when feasible, because of no ionizing radiation used, good soft tissues, can detect hypoxic ischemia, structural brain abnormalities and stroke types (McDonald B et al 2013).

Many scientist said MRI is need to basic investigation for patients new onset seizure with out fever (Tavassoli A et al 2011).

As far as, the American Academy of neurology report that no sufficient argument to recommend routinely use of neuroimaging in children with first a febrile seizure as guideline or as standard for work. They state an indication for special cases in according to history and physical examination. However child with a febrile seizure evaluated mostly by CT scan due parents stress, legal problems when a fear of in correct diagnosis (Aprahamian N et al 2014).

In study conducted in Tehran reported patients with predisposing risk factors have more neuroimaging abnormality than those patients with out such risk factors. They

noted neonatal with predisposing condition for example hypoglycemia, asphyxia, bleeding disorder, malignancy and recent head injury had greater chance to develop neuroimaging abnormality (Mohammadi et al 2013).

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