



## Evaluation of The Role and Utility of Neuroimaging In New Onset Seizures Presenting To The Emergency Department

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**Keywords:** CT Scan, Electroencephalography, Epilepsy, MRI, Neuroimaging, Seizure.

### ABSTRACT

**BACKGROUND:** Epilepsy is defined as recurrent unprovoked seizures. Initial clinical assessment seldom gives a specific diagnosis and this leads to uncertainty about prognosis and further management. Aim of this study was to evaluate the role and utility of Computerized Tomography Scan and Electroencephalography in the setting of new onset seizures presenting to the emergency department.

**METHODS:** In this study, all the emergency patients, above 12 years of age, presenting with onset of new seizures within 72 hours prior to presentation, were included for a period of 1½ year. Patients were investigated about any medications taken and EEG was carried out when possible. CSF analysis was done in those seizures patients who had persistently altered mental status, infectious symptoms, elevated WBC count or fever. Patients were subjected to CT scan head and other investigations were carried out based on clinical history and examination.

**RESULT:** Out of total 110 patients studied, Computerized tomography was done in 88 patients and abnormal findings were found in 44(50%) patients, which is a significant finding. MRI brain was done in only 13 patients and was found to have abnormalities in 12(92.3%) patients. EEG was done in only 20 patients and significant changes were seen in only 3(15%) patients.

**CONCLUSION:** It was concluded that seizures are one of the common presenting complaints in the emergency department. Imaging studies especially CT scan and MRI are an important part of evaluation of patients with new onset seizures and should be done routinely in these patients.

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## Introduction

A seizure is defined as discrete spontaneous alteration in behavior or subjective experience occurring due to an abnormal hypersynchronous excessive discharge of a collection of neurons within the brain. Individuals who suffer a seizure are referred to emergency department because of the concern that seizures are potentially serious and dangerous [1].

A community-based study in UK reported that 21% of newly occurring seizures fall into category of acute symptomatic seizures [2].

The incidence of new onset seizures and etiological profile may depend upon referral pattern of patients in a particular location and the availability of tertiary care hospital facilities including availability of routine biochemical investigations and neuroimaging studies.

Till now, very little is known about the etiological profile of new onset seizures presenting to emergency department. Also the problems presented by seizures in emergency department are neither well defined nor studied. Seizures and epilepsy are not emphasized in studies of ED care and the few specific studies of emergency seizures focus mainly on seizure diagnosis and acute seizure control [1, 3].

The management protocol of these patients and role of neuroimaging studies and EEG in these setting of seizures presenting to the emergency department remain unclear. Very few studies have been done so far till now to address the role of neuroimaging in these patients.

Earlier electroencephalography was the single most commonly used diagnostic study in patients with seizure and it used to be done in each patient who presented with a seizure activity. EEG may be helpful in diagnosing seizures, classifying the seizure type and monitoring response to treatment. However in cases of new onset seizure presenting to emergency department, its usefulness may be limited to confirm the diagnosis of nonconvulsive status epilepticus or to establish the presence of status epilepticus in a patient who has been given long acting paralytic agents to facilitate intubation [4].

CT scan is now considered the imaging modality of choice in patients presenting to the emergency department due to its ease, accuracy and availability. Incidence of abnormal CT scans increases with age. Previous literature had shown abnormal CT scan results in 3 to 41% of patients with first time seizures [5].

William and colleagues (1993) [6] supported CT imaging use only if an abnormal neurologic examination existed or a history of malignancy was present.

Predictors of abnormal CT scans in new onset seizure patients include recent head trauma, abnormal neurological findings, multiple seizures, previous CNS disorders, focal seizures and history of malignancy.

Presently 1.5 T MRI is the imaging study of choice in patients presenting with epilepsy. It is superior to CT scan in identifying abnormalities of cortical architecture. MRI can detect subtle changes, especially in temporal lobes, which is an important advantage, since abnormalities in this region cause a significant percentage of seizures.

When a patient presents to the emergency department with history of seizures, it is important to get an accurate description of the event. The first step is to determine whether the event was truly a seizure and which diagnostic studies are needed [7]. A proper history should be taken and seizures must be differentiated from confusional states, syncope, arrhythmias or pseudoseizures.

It is a standard practice to do all routine biochemical investigations and get an EEG and CT scan in every patient presenting to emergency department, however there are no standard guidelines.

The role of neurologist in the evaluation and management of new onset seizures varies among different institutions. Often the internist first sees the patient and later on neurologist is called. Ictal seizure semiology is identified and then seizures are classified in various categories according to classification proposed by international league against epilepsy (ILAE, 1989) [8].

Seizures are usually a manifestation of an underlying pathology which requires thorough evaluation including a careful history, physical examination, laboratory workup and electroencephalographic and neuroimaging studies as dictated by clinical suspicion. The evaluation and treatment of seizures in emergency department must be comprehensive [9].

Eisner and colleagues [3] in 1986 conducted a study on 163 patients to determine the efficacy of standard seizure workup in patients presenting to emergency department with history of seizures. This included detailed clinical examination, routine blood chemistries and cranial CT scan. This study showed that routine serum chemistries in patients presenting to emergency department is of extremely low yield.

### Role of Electroencephalography:

Electroencephalography is done since long in patients with seizures. However role of EEG in patients presenting to emergency with new onset seizures is less well defined.

EEG helps to define the seizure type and its classification and is also useful in cases when patients are suspected to have nonconvulsive status epilepticus. An urgent EEG in the emergency department is recommended for those patients with persistent altered mental status in whom subtle convulsive or nonconvulsive status epilepticus is suspected. An EEG is also required when a patient motor activity has been suppressed by either paralysis or barbiturate coma and assessment of ongoing seizure activity is needed

An EEG performed, soon after the seizures, is more likely to show any abnormalities than one performed later [10]. EEG after sleep deprivation increases the yield in detecting epileptiform abnormalities.

Hopkins A et al [11] in 1998 did a study on 408 patients and it was found that an EEG in adults is of low yield or negligible value in predicting seizure recurrence after an initial seizure. Also a normal EEG does not disapprove the diagnosis.

Mark et al (1998) [12] studied 300 consecutive adults who presented with unexplained seizures. Epileptiform abnormalities were shown in 43% of first EEG records. Nonepileptiform abnormalities alone were shown in 25% of these EEG records and 3.2% of records were normal. Also epileptiform abnormalities were observed in 80 of 156(51%) patients who had an EEG within first 24 hours, compared with only 49% of 144 patients who had EEG later on. It was found that higher diagnostic yield was due to performing earlier EEG within 48 hours than later EEG done after 48 hours.

**Role of CT scan:** CT scan is often recommended in the evaluation of new onset seizures in the emergency department and may be particularly valuable when cause of seizures is inapparent. It is currently unclear whether CT imaging is needed in all emergency department patients who don't have a readily identifiable explanation for their disorder.

Only few studies have been done so far to study the utility of radiologic investigations on patients presenting to emergency department with new onset seizures. The reported incidence of CT abnormalities ranges from 3% to 41% [13, 5]. It has been found to be high in patients with partial seizures and in those with history of seizures after age of 30 years. Predictors of abnormal CT scans in new onset seizures include recent head trauma, abnormal neurologic findings, multiple seizures, previous CNS disorders, focal seizures and history of malignancy.

An evidence based clinical policy regarding neuroimaging of patients with first time seizures was published in 1996

[14]. According to those recommendations, a head CT scan was advised to be done in patients with history of head trauma, in those patients in which some acute intracranial process is suspected, with history of malignancy, immunocompromise, fever, persistent headache or a new focal neurological deficit and age older than 40 years.

In view of the above literature, we can see that very few studies have been done so far to study the etiology of seizures in patients presenting to emergency department. Some of the studies have suggested routine biochemical investigations in these subsets of patients, while others have advised detailed laboratory workup in these patients. Also the usefulness of doing imaging studies is not clearly defined in patients with first time seizures. So we undertook this study to do detailed clinical workup in patients presenting to emergency department with new onset seizures along with routine investigations and CT scan in particular in these patients.

**Aims and objectives:** To evaluate the role and utility of Neuroimaging and Electroencephalography in the setting of new onset seizures presenting to the Emergency Department.

## Materials And Methods

All the emergency patients above 12 years of age presenting to emergency department with onset of new seizures within 72 hours prior to presentation were included in the study for a period of 1½ year.

All the patients were questioned about duration of onset of seizures, numbers of seizures and seizure semiology was noted as per Luders classification of Luders et al [15]. An attempt was made to assign an electro-clinical syndrome to the seizures according to the 1989 ILAE classification when possible. Seizure clusters were noted within 24 hours, 48 hours and 72 hours and history regarding post-ictal neurological deficit, psychosis and postictal headache was obtained.

Pertinent neurological examination was carried out noting the time of examination and the contributory history to find out the cause of seizures was taken. Patients were subjected to all routine investigations i.e. Haemogram, Urine R/E, Stool R/E, blood sugar, LFT, RFT, Serum calcium, serum phosphorus, serum magnesium and ABG. Patients were investigated about any medications taken and EEG was carried out when possible. CSF analysis was done in those seizures patients who had persistently altered mental status, infectious symptoms, elevated WBC count or fever.

Patients were subjected to CT scan head and other investigations, if indicated, were carried out based on clinical history and examination.

Final diagnosis was made based on ictal, interictal seizure semiology, neurological examination, clinical history and electroclinical classification.

Any treatment given in the form of antiepileptics and other treatment given was noted.

#### **Inclusion Criteria**

1. Age >12 years.
2. New onset seizures in 72 hours prior presentation to Emergency department.

#### **Exclusion criteria**

1. Patients having history of seizures of more than 72 hours prior to presentation in the Emergency department.
2. Diagnosis of non-epileptic seizures.

The patient cohort was analyzed for demographic trends, seizure semiology patterns, Electroclinical classification, Aetiological diagnosis and EEG or imaging abnormalities. For purpose of analysis appropriate statistical tests were applied.

#### **Result**

In this study, total of 110 consecutive patients with new onset seizures who presented to emergency department were included. Patients with age <12 years and with history of head trauma were excluded from the study. The study was conducted for period of one and a half-year. The patients were subjected to routine biochemical investigations including renal function tests, liver function tests, computerized tomography scan head, magnetic resonance imaging brain (where ever needed) and electroencephalography (if possible).

#### **Role of imaging and EEG:**

**Table 1** shows that CT scan was done in total of 88 patients and 44(50%) patients had abnormal findings on CT scan. MRI was done in 13 patients and was found to be abnormal in 12(92.3%) patients. EEG was done in 20 patients and 9 of these patients showed some abnormality. MRI alone was done in 8 patients, out of which 7 (87.5%) patients had abnormal scans. Both MRI and CT scan was done in 5 patients and in this group of patients, CT was normal in two while MRI showed multiple ischaemic foci in one and in another, findings were consistent with diagnosis of acute disseminated encephalomyelitis.

#### **List of patients with abnormal CT scan**

**Table 2** is showing abnormalities detected on CT scan. Forty four (50%) patients showed some abnormality on CT scan. Granulomatous lesion was detected in 13 (29.5%) patients on CT scan. Acute infarct was seen in 9(20.4%)

patients. Other abnormalities seen were chronic infarct (11.3%), ICH (11.3%), SAH (4.5%), diffuse cerebral oedema, multiple ischaemic foci and hydrocephalus.

#### **List of patients in which CT scan not done:**

**Table 3** shows list of patients, in which CT scan was not done and diagnosis made in these patients. Total number of such patients was 22. Out of these, cause remained unestablished in five patients. Uraemic seizures were seen in three patients. In another three, diagnosis of acute infarct was made by MRI findings.

#### **List of EEG findings:**

**Table 4** shows that EEG was done in 20(18.1%) of patients. It was found to be normal in 11(55%) patients. Five patients had mild diffuse encephalopathy. PLEDs were detected in 3 (15%) patients. Among these three patients, diagnosis of presumed viral encephalitis was in 2 patients. In one patient, EEG was suggestive of some structural lesion in left hemisphere and CT scan in this patient showed chronic infarct.

#### **Discussion**

In the present study, we included 110 consecutive patients with history of new-onset seizures who presented to emergency department for a period of one and a half years. We excluded patients who were less than 12 years of age and also had seizures in more than 72 hours prior to admission and with diagnosis of non-epileptic seizures. Patients with history of head trauma were also excluded from the study.

Epileptic seizures are usually easily distinguishable into provoked and unprovoked seizures. Epilepsy is defined as recurrent unprovoked seizures. Initial clinical assessment seldom gives a specific diagnosis and this leads to uncertainty about prognosis and further management. However a good history, thorough clinical examination, routine biochemical investigations and routine neuroimaging are usually sufficient to distinguish between provoked and unprovoked seizures.

**Role of imaging studies:** The indications for performing a CT scan in the emergency department in patients with new onset seizures are controversial and different studies have conflicting results. In our hospital, CT scan is available on site on 24 hours basis without any waiting period while MRI facility is available off site.

Sempere et al (1992) [16] reported structural lesion in 34% of patients on CT scan with first seizure in adult.

Henneman et al (1994) [5] in a retrospective analysis of 333 patients with new onset seizures reported CT abnormalities in 41%.

**Table 1: Role of imaging and EEG**

Investigation	Total patients	Normal	Abnormal
CT Scan	88	44(50%)	44(50%)
MRI Brain	13	1(7.7%)	12(92.3%)
EEG	20	11(55%)	9(45%)
MRI alone	8	1(12.5%)	7(87.5%)
MRI +CT Scan	5	CT normal-2	MRI abnormal-5

**Table 2: List of patients with abnormal CT scan**

Abnormality	Number of patients
Granulomatous lesion	13(29.5%)
Acute infarct	9(20.4%)
Chronic infarct	5(11.3%)
Intracranial haemorrhage	5(11.3%)
Hypodensities	3(6.8%)
Venous thrombosis	3(6.8%)
Subarachnoid haemorrhage	2(4.5%)
Hydrocephalus	1(2.2%)
Diffuse cerebral oedema	1(2.2%)
Multiple ischaemic foci	1(2.2%)
Tumour	1(2.2%)
<b>Total</b>	<b>44</b>

**Table 3: List of patients in which CT scan not done:**

Etiological diagnosis	Number of patients
Unestablished	5
Uraemic seizures	3
Presumed viral encephalitis	3
Acute infarct	3
Organo-chlorine poisoning	2
Organophosphorus poisoning	1
Neurocysticercosis	1
Hypertensive encephalopathy	1
Hyperosmolar coma	1
Venous thrombosis	1
Hepatic encephalopathy	1
<b>Total patients</b>	<b>22</b>

**Table 4: List of EEG findings:**

Finding on EEG	Number of patients
Normal	11(55%)
Mild diffuse encephalopathy	5((25%)
PLEDS	3(15%)
S/O Structural lesion left hemisphere	1(5%)



In another study by Earnest et al (1988) [17] on 259 patients with suspected alcohol withdrawal seizures, 58% had abnormal CT scan results of which 16 (6%) had a clinically significant lesion.

Shoenenberger and Heim (1994) [18] reported abnormal CT result showing structural lesion in 40 (34%) of patients and concluded that diagnostic yield of CT brain in adults after a first generalized seizure is high.

Ramirez et al (1984) [19] demonstrated structural abnormality by CT scan in 55 (37%) of patients. Our study reported abnormal CT scan results in 44 (50%) patients.

Our study results did not match with view of Hopkins et al (1988) [11] who reported normal CT scan in 87.7% of and concluded that CT scan done in patients with first seizures is of no value.

However our study demonstrated abnormalities in 50% of patients with new onset seizure on performing CT scan, which is a significant result and cannot be ignored.

The results of our study are also supported by William et al (2002) [20] who demonstrated some form of CT abnormality in 35% of patients included in his study.

To conclude, we recommend that routine imaging studies of brain, preferably MRI should be performed in patients with new onset seizures.

CT scan is now considered the imaging modality of choice in patients presenting to the emergency department due to its ease, accuracy and availability. Incidence of abnormal CT scans increases with age.

Predictors of abnormal CT scans in new onset seizures include recent head trauma, abnormal neurologic findings, multiple seizures, previous CNS disorders, focal seizures and history of malignancy.

**Role of EEG:** The role of EEG in the evaluation of patients with new onset seizures in ED is not well studied.

Hopkins et al (1988) [11] on a study of 408 patients concluded that routine EEG should not be performed in patients after their first seizure.

Sempere et al (1992) [16] did EEG in 73 patients out of 98 patients studied after their first seizure. 32 cases (43.8%) had normal results, 24(32.9%) showed focal spikes or focal slowing.

We performed EEG in 20 patients and 11(55%) patients had normal results, five patients had mild diffuse encephalopathy. PLEDs were detected in 3 cases.

Although we did EEG in only 20 patients only, our study results are matching with those of Sempere et al (1992) [16].

An EEG performed, soon after the seizures, is more likely to show any abnormalities than one performed later. EEG after sleep deprivation increases the yield in detecting epileptiform abnormalities.

## Conclusion

So, it was concluded in the end that Seizures are one of the common presenting complaints in the emergency department. Imaging studies especially CT scan and MRI are an important part of evaluation of patients with new onset seizures and should be done routinely in these patients.

## Acknowledgements

None

## Funding

None

## Competing Interests

None Declared

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