

Non-Contrast Computed Tomography in Adults with Seizure Disorders

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ABSTRACT

Background: There are numerous causes of epilepsy. A neuroimaging study should be done to exclude a structural brain abnormality. The present study was undertaken to find the role of Computed Tomography (CT) scan in patients presenting to our hospital with seizure disorders. **Methods:** Adult patients who presented to our hospital with history of seizures underwent non-contrast CT scan. Assessment of a radiologist were noted. **Results:** A total of 90 patients were included, 51% had Simple Partial Seizure (SPS), 21% had Complex Partial Seizure and 28% had Generalized Tonic Clonic (GTC) type. No abnormality was found in 37.8% of the patients. Space occupying lesions were diagnosed in 24.4% of the patients, vascular lesions in eight patients, gliosis and encephalitis in seven patients each, tumours and trauma related lesions in six and four patients respectively. Half of all SPS were localised to the frontal lobe. CPS were similarly distributed in the frontal and occipital, had more than one lobe involvement and included bilateral cerebral hemispheres. GTC more commonly involved occipital lobe than frontal or parietal lobe. More than one lobe involvement or bilateral cerebral hemispheres were most common in GTC, as compared to SPS or CPS. Space occupying lesions manifested mainly as SPS or CPS, and none as GTC. Vascular lesions presented as partial seizures only. In those with a normal CT appearance, SPS was most common. **Conclusions:** CT scan provides an easier and cheaper means to diagnose a number of organic lesions which may cause seizure disorders.

Keywords: Computed Tomography; Epilepsy; India; Seizure.

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INTRODUCTION

Epilepsy is a common neurological disorder encountered by neurologists.^[1] The World Health Organization (WHO) has estimated a global prevalence of 50 million people with epilepsy, of which 80% belong to low and middle income countries.^[2] Various epidemiological studies in India have reported prevalence rates ranging between 1.3 and 11.9 per 1,000 population.^[3] There are numerous causes of epilepsy.^[4] Based on the clinical presentation, associated diseases and many other factors, it can become necessary to identify the underlying condition to treat seizures. A neuroimaging study, either Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) should be done to exclude a structural brain abnormality. A brain CT scan is suitable to exclude a mass or cerebrovascular accident under emergency situations, specially if an MRI is unavailable or contraindicated. CT can detect most tumours, large arteriovenous malformations and extensive brain malformations, and infectious lesions as well. In

fact, CT is more sensitive for detecting calcified lesions and bone lesions, which MRI can miss. Therefore, the present study was undertaken to find the role of non-contrast CT scan in patients presenting to our hospital with seizure disorders.

MATERIALS & METHODS

Study Design and Sampling

The present cross-sectional study was conducted in the Department of Radiodiagnosis. Patients who presented to the Emergency Department or Department of Neurology or Medicine with seizures were referred to our department for neuroimaging. After initial patient stabilization, patients or their attendants were explained the purpose of the study and an informed written consent was taken. All adult patients who presented with seizure activity to our hospital during a 12 month period were included in the study. Any patient with history of metabolic abnormality were excluded from the study.

Data Collection and Data Analysis

A pre-designed semi-structured questionnaire was used to collect patient related data. Demographic information like age and gender were noted. Clinical information like number of seizure episodes in the past was noted as well. Patients were diagnosed with

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seizure sub-type based on their clinical presentation by the consultant. Patients were classified as Generalized Tonic Clonic if no focal phenomena at onset happened; Simple Partial Seizure if unilateral motor activity, usually clonic, without or with secondary generalization or sensory or cognitive experience or cessation of behavior without loss of consciousness or motor activity happened; Partial Complex seizures if partial simple phenomena happened with impairment of consciousness, with or without automatism. Non-contrast CT scans were reviewed by a radiologist for anatomical locational and a final diagnosis was made based on imaging results. Patients were scanned using Single Slice Spiral: GE CT/e machine, a modified fifth generation scanner. Slice thickness was 1 mm, 2 mm, 5 mm and 10 mm. The findings of the CT scans were noted for all patients. Data were analysed and tabulated.

RESULTS

Table 1: Baseline characteristics of the patients included in the study

| Variables | n | % |
|----------------------------|----|-------|
| Age distribution | | |
| Less than 20 | 14 | 15.6% |
| 21 to 40 | 23 | 25.6% |
| 41 to 60 | 32 | 35.6% |
| More than 60 | 21 | 23.3% |
| Gender distribution | | |
| Females | 16 | 17.8% |
| Males | 74 | 82.2% |
| Type of residence | | |
| Urban | 32 | 35.6% |
| Rural | 58 | 64.4% |

Table 2: Description of various clinical characteristics of the patients included in the study

| Clinical variables | n | % |
|---------------------------------|----|-------|
| Episodes of seizure | | |
| Single | 27 | 30.0% |
| Two | 20 | 22.2% |
| Three | 16 | 17.8% |
| More than three | 27 | 30.0% |
| Clinical type of seizure | | |
| Simple partial | 46 | 51.1% |
| Complex partial | 19 | 21.1% |
| Generalised tonic clonic | 25 | 27.8% |
| Final diagnosis | | |
| Space occupying lesion | 22 | 24.4% |
| Vascular | 8 | 8.9% |
| Gliosis | 7 | 7.8% |
| Encephalitis | 7 | 7.8% |
| Tumour | 6 | 6.7% |
| Trauma | 4 | 4.4% |
| No diagnosis made | 34 | 37.8% |
| Others | 2 | 2.2% |

During the study period, a total of 90 patients were included in the study. [Table 1] describe demographic variables of the patients. Mean age of the patients was 37.5 ± 6.21 years and 41 to 60 years was the most common age group (35.6%). Least

number of patients were below the age of 20 years. We observed that 82.2% of the patients were males and approximately two thirds had a rural residence. Clinical history obtained from the patients revealed single seizure episode in 30% of the patients, two episodes in 22%, three episodes in 18% and 30% of the patients had more than three episodes. Based on the clinical history and examination, almost half of the patients had Simple Partial Seizure (SPS), 21% had Complex Partial Seizure and rest of the 28% had Generalized Tonic Clonic (GTC) type of seizures. On non-enhanced CT scan, no abnormality was found in 37.8% of the patients, as a result of which no particular diagnosis could be made in these patients. Space occupying lesions were diagnosed in 24.4% of the patients, which included tubercular granuloma and neurocysticercosis [Table 2]. Vascular lesions were found in eight patients, which included chronic infarcts mainly. Gliosis and encephalitis was diagnosed in seven patients each. Tumours and trauma related lesions were found in six and four patients respectively. Other lesions like ventricular cyst and sclerosis was diagnosed in two patients.

Table 3: Clinical seizure type in relation to anatomical location and CT based final diagnosis

| Anatomical location of lobe | Clinical type of seizure | | |
|--------------------------------|-------------------------------|--------------------------------|------------------------------|
| | Simple partial seizure (n=46) | Complex partial seizure (n=19) | General tonic clonic (n= 25) |
| Frontal | 23 | 4 | 0 |
| Parietal | 8 | 0 | 0 |
| Temporal | 6 | 2 | 0 |
| Occipital | 1 | 4 | 3 |
| More than 1 lobe | 4 | 5 | 10 |
| Bilateral cerebral hemispheres | 4 | 4 | 12 |
| Final diagnosis | | | |
| Space occupying lesion | 19 | 3 | 0 |
| Vascular | 5 | 3 | 0 |
| Gliosis | 3 | 1 | 3 |
| Encephalitis | 4 | 1 | 2 |
| Tumour | 0 | 3 | 3 |
| Trauma | 0 | 3 | 1 |
| No diagnosis made | 17 | 5 | 12 |
| Others | 0 | 1 | 1 |

[Table 3] describe the association of clinical type of seizure disorder with anatomical location and CT based final diagnosis. Half of all SPS were localised to the frontal lobe. CPS were similarly distributed in the frontal and occipital, had more than one lobe involvement and included bilateral cerebral hemispheres. None of the CPS case involved parietal lobe. GTC more commonly involved occipital lobe than frontal or parietal lobe. More than one lobe involvement or bilateral cerebral hemispheres were

most common in GTC, as compared to SPS or CPS. Space occupying lesions manifested mainly as SPS (n=19) or CPS (n=3), and none as GTC. Vascular lesions presented as partial seizures only. None of the tumours and trauma lesions presented as SPS. In those without a diagnosis (normal CT appearance), SPS was most common (n=17), followed by GTC (n=12) and CPS (n=5).

DISCUSSION

Seizure activity can occur due to numerous reasons and finding the underlying cause has always been a challenge for neurological experts. Neuroimaging modalities are, in most cases, able to identify many of these cause, as in our study. In the seizure classification system established by the International League Against Epilepsy, auras are called simple partial seizures; "simple" means that consciousness is not impaired and "partial" means that only part of the cortex is disrupted by the seizure.^[5] The symptoms of simple partial seizures vary from one patient to another and depend entirely on where the seizure originates in the brain, that is, the part of the cortex that is disrupted at the onset of the seizure. In our study half of all SPS cases had frontal lobe affected. A seizure that affects the motor cortex will result in rhythmic jerking movements of the face, arm, or leg on the side of the body opposite to the involved cortex (Jacksonian seizure). In contrast to partial seizures, generalized seizures appear to originate in all regions of the cortex simultaneously. In our study, space occupying lesions were the most common pathologies observed on CT scans. This group of patients mostly had tuberculoma granuloma and neurocysticercosis and mainly presenting as SPS. Puri and Gupta found that tuberculoma and neurocysticercosis patients presented more commonly with partial seizures as compared to generalized seizures.^[6] Thus was further supported by the findings of Rathi et al who studied ring lesions in 94 patients and noticed partial seizures were partial in majority of the cases.^[7]

We found abnormalities in 62.2% of the patients with the help of non-contrast CT scans. Sempere et al evaluated 98 patients, and noticed CT abnormalities in 33.7% patients.^[8] Nair et al noted abnormality in 47.7% of the patients.^[9] Schoenenberger and Heim performed CT scans in 119 patients, of which 42.85% were found to have abnormalities.^[10] Henneman et al retrospectively reviewed CT scans of 333 patients, of which 52% were found to be abnormal.^[11] In these studies, CT scans in the emergency department for adult presenting with seizure resulted in a change of acute management in 9 to 17% of patients. Frequent CT abnormalities that changed acute management were traumatic brain injury, subdural hematomas, non-traumatic bleeding, cerebrovascular accidents,

tumors, and brain abscesses. Likewise conclusions have been drawn from pediatric studies as well.^[12]

As for chronic seizures, Reinus et al retrospectively reviewed non-contrast CT scans of 115 patients and found abnormality in 20% of them.^[13] However, evidence for the likelihood of CT imaging study changing management for patients with chronic seizures was not available and thus was not recommended by the authors. Mengistu et al performed a retrospective review of CT neuroimaging in 181 patients with epilepsy.^[14] They demonstrated abnormal intracranial structural lesions in 31% of epileptic patients with CT. The authors concluded that a major proportion of the cases demonstrated focal epileptiform discharges and non-epileptiform features with abnormal intracranial pathologies.

CONCLUSION

CT scan provides an easier and cheaper means to diagnose a number of organic lesions in patients presenting with seizure disorders. As emergency MRI becomes more accessible in India and CT technology improves, studies including both imaging modalities, with a second set of blinded assessors, will be required to understand the role of neuroimaging in the diagnosis and management of seizure disorders.

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