ORIGINAL RESEARCH ARTICLE

Retrospective Analysis of the Role of Computed Tomography in the Evaluation of Children with Seizure

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A B S T R A C T

Introduction: A seizure is defined as "a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain.

Material and Methods: A retrospective study data collection between September 2015 to August 2018 at Department of Radio diagnosis, RK Mission Hospital, Itanagar, Arunachal Pradesh (India). Inclusion Criteria Children between the age of 0 and 14 years presenting with seizures. Exclusion Criteria Any children with evidence of biochemical or metabolic abnormality was excluded.

Results: Records of 184 children with seizures were evaluated for the study of which, 63 patients (34.2%) showed abnormal CT scans. Maximum number of abnormal scans were found to have congenital anomalies (13), followed by granulomas (11), hydrocephalus (9), infections (8) and Hypoxic Ischemic Encephalopathy (HIE) (8), tumours (5), calcification (4), posttraumatic seizures (3), inherited metabolic disorder, possibly Leigh's disease (2). **Conclusion**: Although CT scan is more easily available and has shorter scan time, MRI is superior in the diagnosis of most of the pathologies. Based on this study, it can be concluded that CT scan in children suffering from seizures is extremely useful as almost half of the CT scans were found to be abnormal. It is therefore an excellent tool for screening and also for definitive evaluation of seizures.

Key words: CT Scan, Seizure, Children, Retrospective

INTRODUCTION

A seizure is defined as "a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain".[1]

Seizures are one of the important causes of morbidity and mortality in childhood. Moreover, it is associated with a lot of social stigmas. Therefore, it is very important to establish an accurate diagnosis of seizures and its etiologies in order to appropriately manage such patients. The etiology of seizures is different in developing countries like India as compared to the developed world. Tuberculoma and neurocysticercosis have a relatively high frequency in India.[2] The causes of seizures may vary by age of onset.[3,4] Developmental defects, birth injuries, and metabolic disorders are common causes during the first 2 years of age. Idiopathic seizures are common in the age group of 2-14 years. In adults, trauma, alcohol withdrawal, tumors, strokes, and unknown cause (in 50%) are frequently encountered etiologies, whereas tumor and strokes are common causes in the elderly population.

Although a variety of factors influence the incidence and prevalence of seizures, about 5%-10% of the population will have at least one seizure, with the highest incidence occurring in early childhood and late adulthood. Seizures are one of the most common reason for attendance to the emergency department.[5,6] Around 5% of the population will experience at least one non-febrile seizure during their lifetime.[7,8]

As per the International League Against Epilepsy (ILAE 2017), seizure classification starts with the determination of whether the initial manifestations of the seizure are focal or generalized. If the onset is missed or obscured, the seizure is classified as of unknown onset. The terms "focal" and "generalized" at the start of a seizure name are assumed to represent focal or generalized onset.[1]

Imaging is pivotal in the management of patients with seizure disorders. Structural cerebral abnormalities are more frequently detected in epilepsy patients with modern neuroimaging techniques. Tumors, infarcts, and major malformations are usually detectable on X-Ray computed tomography (CT) imaging. Magnetic resonance imaging (MRI) using appropriate sequences also permits the detection of subtler abnormalities such as hippocampal sclerosis,[9-15] subependymal nodular and band heterotopia, focal cortical dysplasia and small tumours including dysembryoplastic

neuroepithelial tumours.[16]

Magnetic resonance imaging (MRI) is very sensitive and with high resolution in detecting the cause of seizures. CT, on the other hand, is available in most hospitals worldwide and has a relatively low cost of operations. In addition, the logistics of CT make it easier for unstable patients as compared to MRI. CT can detect most tumors (except for some low-grade tumors), large arteriovenous malformations and extensive brain malformations, stroke, and infectious lesions. CT is sensitive for detection of calcified lesions and bone lesions, while MRI often misses these. CT has low sensitivity for detecting small cortical lesions in general and particularly lesions in the base of the skull, as in the orbitofrontal and medial temporal regions. The overall percentage of success of CT in detecting lesions in focal epilepsies is low, approximately 30%. Therefore, although CT may be a good indication for new-onset seizures in an emergency, it is not a substitute for MRI in the investigation of epilepsy.[17]

CT scan is a more commonly available investigation in remote hospital settings than MRI. It is important to find out how useful CT scan is in detecting the causes of seizures. This hospital-based study was undertaken to find the usefulness of CT scan in the evaluation of children with seizure in a remote center in the northeastern part of India.

MATERIAL AND METHODS

This was a retrospective study done by collecting available data between September 2015 to August 2018 at Department of Radiodiagnosis, RK Mission Hospital, Itanagar, Arunachal Pradesh (India). It was conducted in collaboration with the departments of medicine and pediatrics of the hospital.

CT Scan Protocol

Records were considered for non-enhanced CT (NECT) scan was performed in all patients on 128 slices helical CT scanner (Siemens Somatom Perspective, Germany) in the supine position. A reconstructed scan of 1mm slice thickness of both the supra and infra-tentorial neuro-compartments were obtained and used for image interpretation. Axial, sagittal and coronal reformats were used for interpretation. A contrast was given to the selected patients depending upon the indication.

Inclusion Criteria

Children between the age of 0 and 14 years presenting with seizures.

Exclusion Criteria

Any children with evidence of biochemical or metabolic abnormality in hospital reports were excluded.

RESULTS

Total 184 children who presented with seizures and for whom non-enhanced CT scan was done had been retrospectively evaluated from the hospital records. This included 122 males and 62 females.

Out of the 184 cases taken up for study, 63 patients showed abnormal CT scans, i.e., 34.2% of the total scans. The maximum number of abnormal scans (Figure 1) was found to have congenital anomalies i.e. thirteen, followed by granulomas which were found in eleven children. Nine children had hydrocephalus with six obstructive and three

Types	Number of cases
Communicating	6
Non-communicating	3

Table-1: Types of hydrocephalus.

Types	Number of cases
Viral meningo-encephalitis	3
Tubercular meningitis	3
Pyogenic meningitis	2

Table-2: Type of infections.

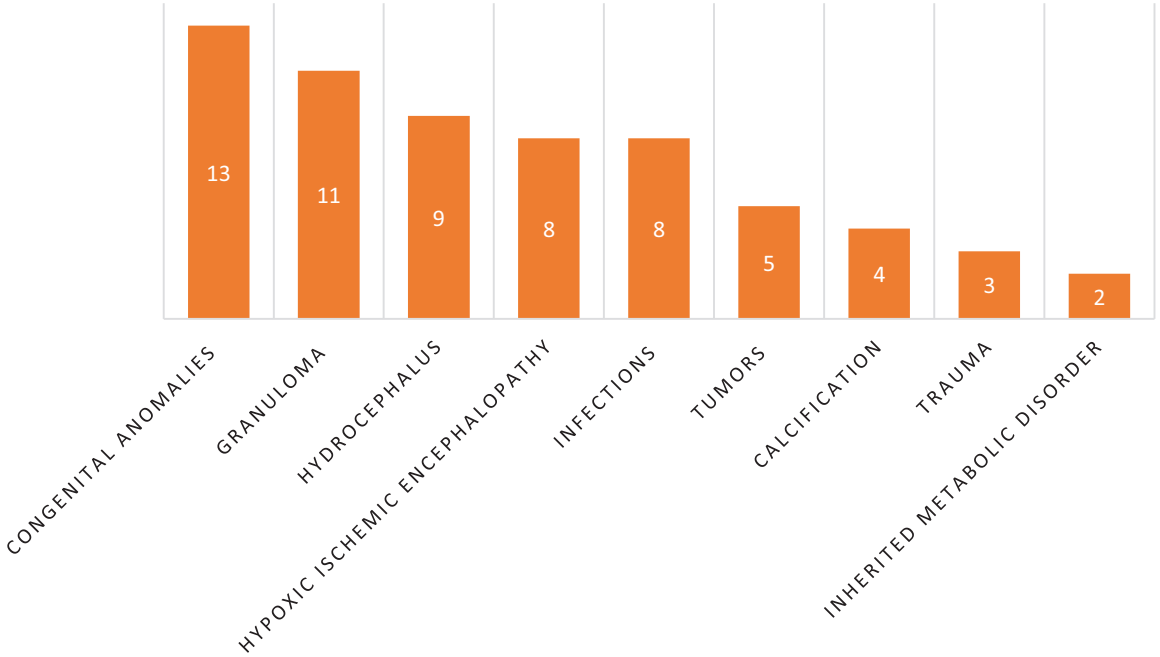

Figure-1: Abnormal CT scan diagnosis in the study

non-obstructive varieties. Infections and Hypoxic Ischemic Encephalopathy (HIE) were responsible for seizure in eight children each. Five presented with tumors. Four children showed calcification. Three children had posttraumatic seizures. Two children showed features of the inherited metabolic disorder, possibly Leigh's disease. (Figure-1, Table1,2)

DISCUSSION

About 4-6% of children present with a history of seizure by the age of 16 years.[18] But to find out the exact cause seizure has been a challenge for decades. Recently with emerging neuroimaging modalities and their advancements, this problem was solved to a great extent. In the present study, we have tried to find out the role of CT scan as a diagnostic imaging modality for seizure in children in a remote setting. In this study 63 out of 184 patients (34.2%) had an abnormal scan. Sipayya and Kashikar reported almost 48% of patients.[19] while Obajimi et al.[20] reported 51.5% of the children had abnormal CT scan in children presenting with seizures.

The most common finding in this study was congenital anomalies comprising 13 cases (7%) of total cases (figure 1). Hsieh et al.[21] had reported abnormal neuroimaging in children presenting with seizures with 16% of the patients detected with congenital anomalies. In another study by Erikkson et al,[22] the incidence of congenital anomalies was found to be 15%. In this study, 3 children had schizencephaly. There were two cases detected each with Dandy–Walker syndrome and corpus callosal agenesis. Arachnoid cyst was found in 2 children. 1 case each of lissencephaly, tuberous sclerosis, nodular heterotopia and hemi-megalenphaly were also detected.

Eleven (6%) patients also presented with granuloma in this study. There were 6 cases of neurocysticercosis. Earlier studies have shown a wide range of detection rates of granuloma. Baheti et al[23] reported an incidence of 3.8% each of neurocysticercosis and tuberculoma. In this study, there were 5 cases (2.7%) of tuberculoma.

In this study, nine cases (4.9%) presented with hydrocephalus. Obajimi et al[20] reported hydrocephalus as the most common finding in children presenting with seizures and seen in 13.6% of the children. In this study, 9 cases of hydrocephalus (6 obstructive and 3 non-obstructive) were detected.

Eight (4.35%) patients were found to have HIE. Eghbalian et al found HIE to be the most common cause of neonatal seizures in a study conducted in Iran. The imaging findings differ in preterm and term babies due to an immature brain in preterm babies.

Infections were found in eight (4.35%) patients. Viral meningoencephalitis and tubercular meningitis were found in 3 children each and 2 children were diagnosed to have pyogenic meningitis. Erikkson and Koivikko[22] reported an incidence of 4% for infections.

In our study, we found five patients (2.7%) presenting with tumors. Four tumors were located in the supratentorial region and there was 1 infratentorial tumor. Ibrahim and Appleto[25] who reported that all tumors causing seizures were supratentorial in location. Erikkson and Koivikko[22] reported an incidence of 2%.

Four patients (2.17%) showed areas of calcification in the CT scan. Previous studies showed a similar incidence of 7.6%.[23]

Three patients (1.6%) presented with posttraumatic seizures. All the three patients had an intracranial hemorrhage. Obajimi et al[20] found 6.8% of the patients with posttraumatic seizures. Depressed fractures can compress the underlying brain parenchyma and may cause damage to the neurons, thereby leading to seizures.

2 children (1.1%) showed features of inborn errors of metabolism. Both the children showed symmetrical hypodensity within the bilateral caudate, lentiform and thalami. A diagnosis of Leigh's disease was made for both the patients.

CONCLUSION

Although CT scan is more easily available and has shorter scan time, MRI is superior in the diagnosis of most of the pathologies. MRI provides the best diagnosis of malformations of cortical development as the gray and white matter junction can be visualized properly. MRI is the modality of choice for diagnosis of tumor extension and also a presence of any hemorrhage within the mass.

Based on this study, it can be concluded that CT scan in children suffering from seizures is useful as more than one-third of the CT scans were found to be abnormal. It is, therefore, an important tool for screening and also for definitive evaluation of seizures especially in a resource-limited setting as it is cheaper and readily available as compared to MRI. Moreover, it is a short investigation and does not require sedation in most of the cases.

It can, therefore, be suggested that CT scan may be used as the screening modality in all children presenting with seizures to diagnose the cause of seizures and to monitor the prognosis.

CT scan plays a very important role as a preliminary tool in the radiological assessment of patients presenting with a seizure. It is valuable in making a diagnosis particularly in developing world, where granulomatous lesions and infections are the most important cause of seizure.

Limitations: This was a retrospective analysis of hospital records. A better conclusion can be made from a similar prospective research on this topic in the future.

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