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Computed Tomography Evaluation of Patients with First Onset Seizure

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Abstract:

- ***Introduction***

Structural neuroimaging plays an important role in the evaluation, management and treatment of first onset seizure. Imaging is performed to establish etiology, assist in determining prognosis, and identifying patients in whom alternation in medical or surgical management would ensue. MRI is considered the imaging modality of choice. CT is the diagnostic imaging test of choice for patients with seizures in a resource limited areas and first onset seizure, where MRI is less practical.

- ***General Objective***

To study the spectrum of Computed Tomography findings in patients with first onset seizure.

- ***Methodology***

A cross section study of patients with first onset seizures who presented to department of radiology and underwent cranial CT scans within the study period. The data was collected through chart review, analyzed by SPSS version 25 and MS Excel 2016.

- ***Results***

Seventy three patients with first onset seizures, 44 males and 29 females with a mean age of 30.1 years, had CT done during the specified period. Thirty-one patients (42.5 %) had normal CT results and forty-two patients (57.5 %) had abnormal results. Neurocysticercosis (NCC) (23.81%), calcified granuloma (21.43 %) and cerebral atrophy (11.9 %) were the most common abnormality. Generalized seizures were seen in 46 patients (63.0%) patients and remaining 27 patients (37 %) had partial seizures. In total 46 cases of generalized seizures, normal CT findings were found in 26 (83.9%) cases and abnormal CT findings were found in 20 (47.6%) of cases. In contrast, among 27 cases of partial seizures, abnormal CT findings were found in 22 (52.4%) of cases.

- ***Conclusion***

Abnormal CT Scans Were More Commonly Seen in Patients with Partial Seizures.

Keywords*: First Onset Seizure, Computed Tomography (CT).*

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I. INTRODUCTION

A seizure is any clinical event caused by an abnormal electrical discharge in the brain.[1] The meaning of the term 'seizure' needs to be carefully distinguished from that of epilepsy. Epilepsy describes a condition in which a person has recurrent seizures due to a chronic underlying process. [2]

A meta-analysis of published and unpublished studies puts the overall prevalence rate of epilepsy in India at 5.59 per 1,000 populations, with no statistically different rates

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between men and women or urban and rural residence. [3] Nepal is a predominantly rural country with a population of 21 million. A community- based survey in Morang district showed that the prevalence of epilepsy was 7.3 per 1,000 populations.[4]

Seizure can be the first manifestation of epilepsy or may be a symptom of brain tumor, infection, stroke or a congenital abnormality that requires special management and treatment.[5]

Neuroimaging plays an important role in workup of patients with epilepsy. Magnetic resonance imaging, specially the 3 tesla MRI is the imaging of choice because of its ability to detect small lesions like mesial temporal sclerosis, cortical dysplasias, small tumors, etc that are not detected by conventional MR or CT scan of brain. Identification of these lesions often helps in managing refractory epilepsies more effectively. However, cost and non-availability of MR in large part of the country necessitate the use of CT as an alternative being initial investigation and also useful in acute situations.[6]

CT can accurately detect hemorrhage, infarctions, gross malformations, ventricular system pathologies and lesions with underlying calcifications. In older children and adults, CT is technique of choice in the perioperative state because it can rapidly detect hemorrhage, hydrocephalus and major structural changes.[7]

In the Emergency department, computed tomography (CT) is often easily available and therefore preferred over magnetic resonance imaging (MRI).

MRI is the preferred imaging method because it has greater sensitivity for detecting abnormalities than CT. However, patients with acute seizures initially should undergo CT because it more accurately detects acute bleeding and is reasonably sensitive in detecting other abnormalities.[8]

Previous studies suggest that emergency brain CT leads to an acute change in management in 1.8-17% of cases.[9]

A. Objectives

➢ *General Objectives*

To study the spectrum of Computed Tomography findings in patients with first onset seizure.

➢ *Specific Objectives*

- To identify the etiological factors for first onset seizure.
- To determine the common imaging abnormality in patients with first onset seizure.
- To determine the common imaging abnormality in various age group of patients with first onset seizure.
- To determine association of seizure type with normal and abnormal CT.

II. METHODOLOGY

This cross-sectional descriptive study was conducted in the Department of Radiodiagnosis, NMCTH, Birgunj, using secondary data from 1st August 2020 to 31st July 2021. A total of 73 patients with first-onset seizures who underwent brain CT were included, with sample size calculated using Cochran's formula. Non-contrast CT scans were performed on a Siemens 32-slice scanner (5 mm axial sections, 15–20° gantry tilt along the canthomeatal line), with contrast used when necessary. Axial, coronal, and sagittal reformats were reviewed.

Seizures were classified as either generalized or partial, and patients were grouped by age: ≤20, 21–40, 41–60, and >60 years. Informed consent was obtained prior to scanning.

Data were edited, coded, and entered into Microsoft Excel and SPSS (v25/26). Descriptive statistics (frequency, percentage) were used, and chi-square test assessed associations between seizure type and CT abnormalities, with significance set at $p \leq 0.05$.

III. OBSERVATIONS AND RESULTS

Out of 73 patients, 44 (60.28%) males and 29 (39.72%) females. Their age range was 1 year to 78 years. The mean age was 30.1 years (SD +/- 20.2). Highest numbers of percentage were from ≤20 year age group – (42.5 %) and least percentage of patients were from ≥60 year age group (10.9 %).

The total number of normal CT scans was 31 (42.47%) and abnormal CT scans were 42 (57.53%)

Table 1: Spectrum of Abnormal CT Findings

CT Findings	N=73	%
NCC	10	23.81
Calcified granuloma	9	21.43
Cortical atrophy	5	11.90
TB	3	7.14
CVA	3	7.14
Malignancy	3	7.14
Arachnoid cyst	2	4.76
Arteriovenous malformation	1	2.38
Gliotic changes	1	2.38

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Cerebral Abscess	1	2.38
Cerebral venous sinus thrombosis	1	2.38
Fahr's Disease	1	2.38
Hydrocephalus	1	2.38
Schizencephaly	1	2.38
TOTAL	42	100

Table 2: Relation Between CT Findings and Type of Seizure

CT Findings	**Seizure Patterns**	
	Generalized N (% within CT Finding)	**Partial N (%within CT finding**
Normal	26 (83.9)	5 (16.1)
NCC	4 (40.0)	6 (60)
Calcified granuloma	4 (44.4)	5 (55.6)
TB	1 (33.3)	2 (66.7)
CVA	1 (33.3)	2 (66.7)
Cortical Atrophy	3 (60)	2 (40.0)
Malignancy	1 (33.3)	2 (66.7)
Arachnoid cyst	1 (50.0)	1 (50.0)
Schizencephaly	0 (0.0)	1 (100)
Hydrocephalus	0 (0.0)	1 (100)
Gliotic change	1 (100)	0 (0)
Fahr's disease	1 (100)	0 (0.0)
Cerebral venous sinus thrombosis	1 (100)	0 (0.0)
Cerebral Abscess	1 (100)	0 (0.0)
Arteriovenous malformation	1 (100)	0 (0.0)
TOTAL	46	27

Table 3: Relation Between Various CT Findings and there Distribution Percentage in Various Age Groups:

CT Findings	**Age groups**				
	≤20 years N (%)	**21-40 years N (%)**	**41-60 years N (%)**	**>60 years N (%)**	**Total N (%)**
Normal	15 (48.4%)	13 (61.9)	3 (23.1)	0 (0.0)	31 (42.5)
NCC	6 (19.4)	2 (9.5)	2 (15.4)	0 (0.0)	10 (13.7)
Calcified granuloma	2 (6.5)	5 (23.8)	2 (15.4)	0 (0.0)	9 (12.3)
TB	1 (3.2)	1 (4.8)	1 (7.7)	0 (0.0)	3 (4.1)
Cortical Atrophy	1 (3.2)	0 (0.0)	1 (7.7)	3 (37.5)	5 (6.8)
CVA	0 (0.0)	0 (0.0)	0 (0.0)	3 (37.5)	3 (4.1)
Malignancy	0 (0.0)	0 (0.0)	2 (15.4)	1 (12.5)	3 (4.1)
Arachnoid cyst	2 (6.5)	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.7)
Schizencephaly	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Hydrocephalus	1 (3.2)	0 (0.0)	0(0.0)	0 (0.0)	1 (1.4)
Gliotic change	0 (0.0)	0 (0.0)	0(0.0)	1 (12.5)	1 (1.4)
Fahr's disease	0 (0.0)	0 (0.0)	1 (7.7)	0 (0.0)	1 (1.4)
Cerebral venous sinus thrombosis	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Cerebral Abscess	0 (0.0)	0 (0.0)	1 (7.7)	0 (0.0)	1 (1.4)
Arteriovenous malformation	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Total	31	21	13	8	73

Table 4: Relation Between Seizure Type and the Rate of Abnormal/Normal CT Findings

Seizure Type	**Normal CT N (%)**	**Abnormal CT (%)**	**Total N (%)**	**P value**
Generalized Seizure	26 (83.9)	20 (47.6)	46 (63.0)	
Partial Seizure	5 (16.1)	22 (52.4)	27 (37)	
Total	31 (100)	42 (100)	73 (100)	0.002

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Table 4 shows the resulting p value of <0.005 suggest that the rate of abnormality is significantly higher for partial seizure 52.4 % as compared to only 16.1 % for generalized seizure. Likewise, the normal rate is significantly higher for generalized seizure (83.9 %) as compare to only 26.47 % for partial seizure.

IV. DISCUSSION

In this study, from August 2020 to July 2021, a total number of 73 patients were included with no significance on variation of sex.

In our study, most seizures occurred in patients ≤20 years (31 cases, 42.5%), followed by 21–40 years (21 cases, 28.8%), 41–60 years (13 cases, 17.8%), and >60 years (8 cases, 10.9%). Thus, the majority were below 20 years, similar to Lavados J et al., who also reported that first seizures commonly occur before 15 years of age. [10]

In our study, CT scans were abnormal in 42 patients (57.5%) and normal in 31 (42.5%). Similar findings were reported by Smith et al. (56.8%)[11] and Arruda et al. (44.3%)[12]. Lower rates were observed by Yang et al. (33%)[13], Pathan S et al. (33.3%)[14], Kotisaaari et al. (12%)[15], and Zarmehri B et al. (27%)[16].

These variations in CT scan abnormalities may be explained by differences in patient selection, sample size, geographic location, and scanning techniques.

In our study, 47.5% of patients with generalized seizures had abnormal CT findings, comparable to Schoenenberger et al., who reported 34%.[17]

In our study, CT abnormalities were more frequent in partial seizures, while 83.9% of generalized seizures had normal scans. Similarly, Ashraf M et al. reported normal CTs in 77.4% of generalized seizures and abnormalities in 52.4% of partial seizures.[18] McAbee GN et al. found 95.1% normal CT among generalized seizures.[19]

In our study, the most common abnormalities were neurocysticercosis (23.8% of abnormal, 13.6% of all CT findings), calcified granuloma, and tuberculoma. Among patients <20 years, NCC was most frequent (19.4%), consistent with Garvey et al.[20], Nair et al.[21], Poudel. et al.[22], Ojha, et al.[23] and Gauchan et al.[24] which was 1.0%,10.10%,12.1%,2.4% and16% respectively. In contrast, Adhikary et al. found significantly higher frequency that is 59.5% of NCC cases in western Nepal (Pokhara).[25] The high NCC rate in our study likely reflects socioeconomic factors such as poverty, illiteracy, poor hygiene, and inadequate sanitation.

In our study, calcified granuloma was the most common CT finding in ages 21–40 and the second most common overall (12.3%), similar to Acharya et al.[26] As calcified granuloma is sequalae of neurocysticercosis and neurocysticercosis is already high in this region so number of calcified granuloma might be also high.

In our study, 3 patients (4.1%) with known tuberculosis presented with first-onset seizures, and CT showed tuberculomas with rim enhancement and edema. Similar findings were reported by Weisberg et al.[27], Acharya S et al. (4.1%)[26], and Wadia et al., who also found tuberculoma as a cause of seizures in endemic regions.[28]

In our study, 3 patients >60 years with seizures had CVA. Similarly, Forsgren et al.[29] and Myint PK et al.[30] reported stroke as a common cause of first-onset seizures in the elderly.

Likewise, hydrocephalus was seen in 1.3 % of abnormal CT result which is similar to other studies done by Ashraf M et al.[18]and Poudel. P et al.[22]

In our study, one first-seizure case had gliotic changes post-hemorrhagic stroke, consistent with Myint PK et al., who linked seizures to gliotic scarring and altered neuronal excitability.[30]

In our study, 3 patients with first seizures had primary brain malignancies, consistent with Maschio M et al., who noted seizures as a presenting symptom of brain tumors.[31]

In our study, one case of congenital schizencephaly presented with seizure, aligning with Denis D. et al., who reported seizures in over one-third of 30 cases.[32]

Two patients in our study with first seizures had arachnoid cysts, consistent with Arroyo S et al., who reported similar findings.[33]

In our study, one patient with cerebral venous sinus thrombosis presented with a first seizure, supporting findings by Kalita J et al.[34], who reported seizures in a significant proportion of such cases. In our study, one patient with a cerebral abscess presented with first-onset seizure, consistent with Kilpatrick C, who reported seizures as a presenting feature.[35]

In our study, one patient with Fahr's disease presented with a first seizure, consistent with Acharya S. et al., who also reported seizures in Fahr's disease.[26]

CT brain is a valuable first-line tool for evaluating seizures, accurately detecting morphological abnormalities and establishing etiology in lesions like tumors, post-traumatic, ischemic, or infectious changes. Contrast enhancement improves diagnosis. Despite radiation, CT's availability, affordability, and speed make it essential, especially in developing countries like Nepal, where infections such as NCC and TB are common causes.

V. LIMITATIONS OF THE STUDY

The study is cross-sectional study and study population does not truly include and represent the whole population of first onset seizure as there are many patients with similar clinical features who might have presented to other health centers. We did not investigate the relationship between risk factors

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that include headache or history of malignancy and abnormal CT scan findings in patients with a first seizure. Thus, result of study may vary and may be hard to generalize.

VI. CONCLUSION

This is a descriptive cross sectional study done in the 73 patients who presented with first onset seizures and had CT scan done in Radiology Department of National Medical College, Birgunj within the study period.

CT scans were abnormal in 57.5 % of the total cases. Generalized seizures were the most common. Abnormal scan was reported significantly high in the patients with partial seizure.

The highest incidence of seizure was found in ≤20 years age group. The most common CT scan finding in ≤20 years age group, 21-40 years age group, 41-60 years age group was found to be normal CT scan study. Most common abnormal CT finding in below 20 years age group was NCC followed by Calcified granuloma and tuberculoma. Most common abnormal CT finding in 21-40 years age group was found to be NCC followed by calcified granuloma. Most common abnormal finding in 41-60 years age group were NCC, Calcified granuloma and malignancy. Most common abnormal CT finding in >60 years was CVA.

With this information the study hopes to empower neurophysians and neurosurgeons alike, to make prompt decision regarding diagnosis and treatment of the seizure. This information is also essential to guide them to determine which type of seizure requires CT scans and may produce positive CT scan findings. Therefore, unnecessary exposure to patient could be lowered.

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