Neuroimaging observations in a cohort of elderly manifesting with new onset seizures: Experience from a university hospital

Sanjib Sinha, Parthasarathy. Satishchandra, Balaji Rameshrao Kalband, Rose Dawn Bharath,1 Kandavel Thennarasu2

Department of Neurology,1 Neuroimaging and Interventional Neuroradiology,2 Biostatistics, National Institute of Mental Health and Neuro Sciences, Bangalore, Karnataka, India

Abstract

Background: The occurrence of epilepsy is higher among elderly patients. The clinical manifestations of seizures, causes of epilepsy, and choice of anti-epileptic drugs (AEDs) are different in elderly people with epilepsy compared to the young. Aim: To evaluate the imaging (CT/MRI) observations in elderly patients manifesting with new-onset seizures. Materials and Methods: Two hundred and one elderly patients with new-onset seizures, >60 years (age: 68.0 ± 7.5 years; M:F = 1.8:1) from Jan’ 07 to Jan’ 09, were prospectively recruited. Observations of cranial CT scan (n = 201) and MR imaging (n = 43) were analyzed. Results: The type of seizures included: Simple partial (42%), generalized tonic-clonic (30.3%), and complex partial (27.4%). The pattern of epilepsy syndromes were acute symptomatic (42.3%), remote symptomatic (18.4%), cryptogenic (37.8%), and idiopathic (1.5%). Seizures were controlled with monotherapy in 85%. The CT scan (n = 201) revealed cerebral atrophy (139), mild (79), moderate (43), and severe (18); focal lesions (98), infarcts (45), hemorrhages (18), granuloma (16), tumor (15) and gliosis (4), and hemispheric atrophy (1), white matter changes (75) and diffuse edema (21). An MRI (n = 43) showed variable degree of cerebral atrophy (31); white matter changes (20); focal cerebral lesions (24); - infarct (7); intracranial hemorrhage (6); granuloma (5); tumor (6); gliosis (1); hemispheric atrophy (1); and prominent Virchow-Robin spaces (7); and UBOs (12). Patients with focal lesions in neuroimaging more often had partial seizures, symptomatic epilepsy, past stroke, focal deficit, absence of diffuse atrophy, focal EEG slowing, abnormal CSF, seizure recurrence at follow-up (P < 0.05). Conclusions: Brain imaging observations in elderly patients with new-onset seizures revealed underlying symptomatic nature, hence the etiology and thereby assisted in deciding the specific therapy.

Key Words

Computerized tomography, Magnetic resonance imaging, seizures in elderly

For Correspondence:
Dr. Sanjib Sinha, Additional Professor of Neurology, National Institute of Mental Health and Neurosciences, Hosur Road, Bangalore – 560029, Karnataka, India. E-mail: sanjib_sinha2004@yahoo.co.in

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Introduction

Old age is the most common time in life to develop epilepsy, and population-based studies indicate that seizure disorders increase in incidence and prevalence after the age of 60 years.1-6 Data reported from the Veterans Affairs Cooperative Study #428 suggest that more than one-third (38.3%) of patients experienced CPS, usually of extratemporal origin. The increased occurrence of partial seizures of frontal origin among elderly is linked to the common occurrence of post-stroke epilepsy in this population and vascular afflictions of the anterior frontal cortical areas of brain seen frequently among stroke patients.7 Acute stroke is the most common cause of acute symptomatic seizures in the elderly, accounting for up to half of the cases.1,4 Remote symptomatic seizures occur in survivors of stroke, head trauma, brain tumors, and central nervous system (CNS) infections. The highest rate of occurrence is seen in the first year following the cerebral insult. Pathologies, such as stroke and head injury, can give rise to both acute and remote symptomatic seizure. Nevertheless, almost 50% of epilepsy patients over the age of 60 years experience seizures of unknown etiology.1,8,9 Because of higher chance of detecting underlying lesion responsible for seizures among the elderly patients, neuroimaging is a must in all patients.

Exclusive studies focusing on neuroimaging observations in elderly patients with new onset seizures are far and few. The
aim was to evaluate the imaging (CT/MRI) observations and its role in establishing the etiology in elderly patients manifesting with new onset seizures.

Materials and Methods

This prospective study included 201 elderly people aged above 60 years (age: 68.0 ± 7.5 years; M:F = 1.8:1) who manifested with new onset seizures from Jan’ 2007 to Jan’ 2009 to the neurological services, in a tertiary care university teaching hospital in south India. The study was approved by Institutional Ethics Committee. Patients with epilepsy and onset before the 60 years of age were excluded.

Definitions

Elderly
The United Nations identifies populations who have reached the age of 60 years as “elderly.”[10]

Status epilepticus
Status epilepticus is defined as any seizure lasting for 30 minutes or longer or intermittent seizures lasting for greater than 30 minutes, from which the patient did not regain consciousness.[11] However, there is recent trend of including 5 minutes as SE.

Cluster attacks
A seizure cluster is considered to be the occurrence of three or more seizures within a 24-hour period, as previously defined.[12]

Definitions of the epilepsy syndromes
The definitions of epilepsy syndromes as laid by the revised classification of epilepsies and epileptic Syndromes of the ILAE[13,14] were used.[15-17]

Co-morbidity
The term co-morbidity refers to the co-occurrence of more than one condition in the same person. In patients with epilepsy, the other coexistent conditions may precede, accompany, or follow the diagnosis of epilepsy.[18]

Study proper
Those patients satisfying the inclusion criteria and providing consent for the study were recruited. They underwent following evaluation:

Clinical evaluation
All the patients at baseline were evaluated with detailed neurological examination including mini mental state examination (MMSE). The phenotypic classification of the seizures was performed on historical account of the event and associated features. Seizure types were classified in accordance with ILAE 1981 criteria. The epilepsy syndrome classification was assigned in accordance with revised classification of epilepsies and epileptic syndromes of the ILAE (1989).[13] Patients and their relatives were inquired regarding the co-morbidities in the form of substance abuse, systemic illnesses such as diabetes mellitus, hypertension, internal malignancy, and other important events in the past such as head injury, stroke in the past. Detailed documentation of anti-epileptic drugs (usage), seizure control at discharge and at follow-up, adverse effects of AEDs, parenteral AEDs for SE was obtained. Final etiological diagnosis, mortality rate, and its causes were analyzed. All the patients underwent EEG, detailed serum biochemical assay for glucose, electrolytes, liver and renal functions. Cerebrospinal fluid (CSF) test with routine and chronic meningitis work up, cytopsin for abnormal cells, and virological studies were done as required and on the basis of clinical presentation. Besides these, patients underwent evaluation with chest X-ray, ultrasound abdomen, cardiac echo, routine ECG, and thyroid function tests (T3, T4, TSH) wherever deemed necessary.

Neuroimaging
All the patients underwent brain imaging in the form of computerized tomography (CT) scan of the brain (plain scan in all and contrast-enhanced CT whenever considered necessary). The MRI of brain (n = 43) was carried out, based on clinical indications, feasibility, and affordability after obtaining an informed consent on a Siemens-Magnetom Vision 1.5 Tesla MRI scanner using standard protocols. Spin echo (SE) T1-Weighted (TR = 650 ms, TE = 14 ms) images in axial and sagittal planes were taken, with acquisition time of 2.5 minutes, matrix of 256 X 256 and a 230 mm field of view (FOV). Axial and coronal images of T2-weighted images (TR = 4000 ms, TE = 120 ms) were acquired. Fluid attenuated and inversion recovery (FLAIR) sequences were obtained in axial plane (TR = 9000 ms, TE = 119 ms, TI = 2457 ms). The slice thickness was 5 mm. MRI sequences included T1 (with and without contrast), T2, FLAIR in all, diffusion-weighted imaging (DWI)/ apparent diffusion coefficient (ADC), and MR spectroscopy (MRS) in some of the patients.

All the clinical, EEG, imaging (CT/MRI), and laboratory data thus obtained was entered onto a predesigned proforma (Appendix) and was subsequently entered in a digital spreadsheet.

Statistical analysis
ata was expressed using descriptive statistics such as mean, standard deviation, frequency, and percentage. Chi-square test and Fisher’s exact test were used to find association between categorical variables. Comparison between groups for continuous variables was carried out by independent sample t test or ANOVA, depending upon number of groups. P value < 0.05 was considered significant.

Results

The mean age of the patients was 68.0 ± 7.5 years. Two third patients were male (n = 131, 65.2%); M: F was 1.8:1. The most common type of seizure noted was simple partial seizures (n = 84; 42%), followed by generalized tonic clonic seizure (n = 61; 30.3%), and complex partial seizure (n = 55; 27.4%). Among 84 patients with simple partial seizures, 80% (n = 67) had secondary generalization, while a third of 55 patients with complex partial seizures had secondary generalization. The type of epilepsy syndromes included, a) localization related: Acute symptomatic - 85; cryptogenic - 76; remote symptomatic - 37 and b) generalized: Idiopathic – 3. The post-ictal manifestations included drowsiness (33.8%), confusion
(22.4%), coma (29.4%), and altered behavior (3.5%). The post-ictal period extended from brief period of 10 minutes to even protracted period of 4 days. The mean score on Glasgow coma scale (GCS) at presentation was 13.6 ± 2.19 (range: 6 to 15). Focal neurological deficits were observed in 39 patients. Abnormal serum biochemical parameters were detected in 36 patients and were related to serum glucose (hyperglycemia: 16; hypoglycemia: 1) and electrolytes (sodium/potassium: 13; calcium/phosphorus: 8).

**CT (Brain) Observations (n = 201)**

The interval between onset of seizures and CT scanning ranged from 1 to 20 days (mean: 1.2 ± 0.7). The details of CT scan observations are mentioned in Table 1. Focal lesions were observed in 98 (48.8%) patients. Besides focal cerebral lesions, many patients were noted to have age-related changes such as cerebral atrophy (69.2%) and age-related white matter changes (37.3%). The type and severity of the cerebral atrophy and its grading on visual scale is depicted in the table. Age-related white matter changes in the subcortical white matter and periventricular region were observed in 75 patients, and on gradation of these, changes were done as per the newly proposed ARWMC scale of European task force. The mean ARWMC score increased with the advancing age. Patients with simple partial seizures, especially those with secondary generalization, those with focal deficits at presentation, lower Glasgow coma score at presentation, longer duration of post-ictal state and focal slowing on EEG, were more often found to have focal lesions on CT brain. Recurrence of seizures during follow-up was found to be not associated with the presence of focal lesion on CT brain. [Table 2] Comparing the yield of CT brain with that of MRI, it was noted that among 43 patients who had an MRI brain, 24 (55.8%) were detected to have focal lesions. Among these, 24 patients with focal lesions detected on MRI, 23 were also detected on CT to have focal lesions [Figure 1 a-h].

**MRI (Brain) Observations (n = 43)**

Focal cerebral lesions were found in 24 (55.8%) patients. Besides these focal lesions, other changes observed were cerebral atrophy (72.1%) and age-related white matter changes (46.5%). Interestingly, one patient had hemispheric atrophy. The age-related changes were prominent VR spaces (n = 7) and UBOs (n = 12). The details of MRI findings are mentioned in Table 1. Patients without focal lesions on MRI were found to have significantly higher frequency of alpha waves on EEG. Patients with focal lesions on MRI were more likely to have focal slowing on EEG, an abnormal EEG, and these were the patients who had seizure recurrence at follow-up. The other significant differences in patients with focal lesions on MRI were similar to those CT lesions. [Table 3, Figure 2 a-h].

In patients with simple partial seizures, good clinico-radiological correlation was noted while in those with complex partial seizures though underlying abnormalities on imaging were observed; clinical lateralization was not possible in most occasions due to poor eye witness account and lack of video-EEG.

**Etiology**

In this cohort, etiology could be ascertained in 122 (60.7%) patients. In the remaining, 76 patients were considered to have cryptogenic epilepsy. The most common etiology was presence of an old arterial infarct (n = 26), followed very closely by metabolic causes (n = 25). Acute arterial infarct accounted for seizures in 18 patients. CNS tumors were found in 10 patients, most common being meningioma. Metastases were seen in 3 patients. The etiologic diagnoses in patients with

![CT scan findings of elderly patients with new onset seizures](image-url)
Table 1: Neuroimaging (CT/MRI) features in elderly patients with seizures

| Imaging findings                  | CT (n = 201) | MRI (n = 43) |
|-----------------------------------|-------------|-------------|
| Focal lesions                     |             |             |
| Type of Focal lesions             |             |             |
| Ischemic stroke                   | 45 (45.9%)  | 7 (28.0%)   |
| Intracranial hemorrhage (ICH)     | 18 (18.4%)  | 6 (24.0%)   |
| Granuloma                         | 17 (17.3%)  | 5 (24.0%)   |
| Space occupying lesion            | 15 (15.3%)  | 5 (20.0%)   |
| Gliosis                           | 3 (3.1%)    | 1 (4.0%)    |
| Type of Ischemic Stroke           |             |             |
| Old infarction                    | 25          | 4 (57.2%)   |
| Fresh infarction                  | 18          | 3 (42.8%)   |
| Old + Fresh infarction            | 2           |             |
| Type of ICH                       |             |             |
| Acute cerebral hemorrhage         | 10          | 1           |
| Subarachnoid hemorrhage           | 3           | 0           |
| Subdural hemorrhage               | 2           | 0           |
| Extradural hemorrhage             | 1           | 0           |
| SAH + SDH                         | 1           | 0           |
| Old cerebral hemorrhage           | 1           | 5           |
| Type of Granuloma                 |             |             |
| Calcified granuloma               | 10          | 3           |
| Cysticercal granuloma             | 6           | 2           |
| Tuberculoma                       | 1           | 0           |
| Type of Space occupying lesion    |             |             |
| Low grade glioma                  | 2           | 2           |
| High grade glioma                 | 3           | 1           |
| Meningioma                        | 5           | 1           |
| Metastases                        | 2           | 1           |
| Arachnoid cyst                    | 3           | 0           |
| Diffuse edema                     | 21          | 4           |
| Cerebral Atrophy                  | 139         | 31          |
| Type of Atrophy                   |             |             |
| Cortical                          | 70          | 20          |
| Sub-cortical                      | 6           | 1           |
| Diffuse                           | 62          | 9           |
| Hemispheric atrophy               | 1           | 1           |
| Grade of Atrophy                  |             |             |
| Mild                              | 78          | 18          |
| Moderate                          | 43          | 8           |
| Severe                            | 18          | 5           |
| White Matter Changes              | 75          | 20          |
| UBO                               | 0           | 12          |
| VR spaces                         | 0           | 7           |

provoked seizures (acute symptomatic) and unprovoked seizures (idiopathic/ cryptogenic/ remote symptomatic) were as depicted in Table 4.

Discussion

The most common type of seizure was simple partial seizures (42% of the patients) and majority (80%) had secondary generalization. There were focal lesions on CT brain in 98 (48.8%) patients and in 24 (55.8%) patients with MRI brain. All but 3 patients had localization-related epilepsy. Symptomatic epilepsy was present in 122 patients (60.7%) in this cohort while the remaining 76 patients had cryptogenic epilepsy. Three patients had generalized spike and wave activity on EEG, suggesting an idiopathic generalized epilepsy (IGE) syndrome. Although rare, isolated first manifestations of presumed IGE at an advanced age have been reported.[19,21] The common etiologies in this study included old ischemic infarct (n = 26), metabolic (n = 25), acute infarct (n = 18), and brain tumor (n = 10). Stroke is the commonest cause of symptomatic seizures in the elderly, accounting for 50-64% in large cohorts.[22,32]

Brain imaging using CT or MRI should be considered as part of the diagnostic evaluation of the adult presenting with a first seizure (level B). Cranial CT has an advantage because of its value in the emergency situations, but an MRI is regarded by experts as having a higher yield and is often preferred in non-emergency situations. However, both MRI and CT are of value and have a significant yield of about 10%, and may add to determine the risk for seizure recurrence.[23] Underlying abnormalities such as infarctions, neoplasms, and vascular malformations can be identified in 80% of cases. Developmental lesions and mesial temporal sclerosis, though rare in elderly, can be uncovered in those with refractory epilepsy.[24] In elderly patients, the challenge lies in differentiating the pathologic lesions from the commonly encountered findings viz. cerebral atrophy, age-related white matter changes (ARWMCs)/ leukoaraiosis, prominent Virchow-Robin (VR) spaces, unidentified Bright Objects (UBOs).

The focal lesion on CT brain was detected in 98 (48.8%) patients, and these included: Ischemic infarcts (45), intracranial hemorrhage (19), granuloma (16), tumor (16), and gliosis (3). Diffuse edema was noted on CT brain of 21 patients. Patients with SPS, especially those with secondary generalization, focal deficits, longer post-ictal state and focal slowing on EEG, were more often found to have focal lesions on CT brain. In a sub-analysis of 123 elderly patients enrolled in the VA Cooperative Society # 428, 18% had normal scan, 42.6% stroke, 40.9% displayed small-vessel disease while diffuse atrophy was identified in 35%.[7] In our study, cerebral atrophy (n = 139, 69.2%) and white matter changes (n = 75, 37.3%) were frequent. In a recent study of epilepsy in the middle-aged and elderly individuals, Paradowski and Zagrangek described the leukoaraiosis to be pro-epileptogenic, especially in those over 74 years of age. They found leukoaraiosis to be much more frequent in patients over 65 years of age.[25]

MRI-revealed focal cerebral lesions were found in 24 (55.8%) patients and included: Ischemic infarcts (7), intracranial hemorrhage (6), granuloma (5), tumor (5), and gliosis (1). Other changes observed were cerebral atrophy (n = 31; 72.1%), white matter changes (n = 20; 46.5%), prominent Virchow Robin (VR) spaces (7), and unidentified bright objects (UBOs: 12). Comparing the yield of CT brain with that of MRI, it was noted that among 24 patients with focal lesions on MRI, 23 also had lesions on CT. However, needless to say that the nature of the focal lesion was better delineated on MRI, giving a better diagnostic yield. Patients with focal lesions on CT and MRI also had focal slowing of BGA in the EEG, and those with an abnormal EEG had more chance of seizure recurrences.

The mechanisms for development of white matter changes (WMC) might be enlarged VR spaces, ischemia, degeneration of
myelin and axons with increased intracellular and extracellular water content, and gliosis. It has been hypothesized that these silent white-matter changes could be epileptogenic. Indirect support comes from a study of new-onset risk of epilepsy in multiple sclerosis to be fourfold. Another mechanism postulated for causation of seizures by white matter pathology is that it can cause an indirect global decline in cerebral blood flow and oxygen consumption in cortices. Regesta et al. detected cryptogenic cerebral atrophy (CCA) in 73 (36.8%) patients: Cortical in 37 (50.7%), sub-cortical in 5 (6.8%), and cortico-subcortical in 31 (42.5%) patients. Seizures were generalized in 71.2%, and focal in 28.8% with low occurrence and good therapeutic response. The authors postulated that CCA may lower the seizure threshold in predisposed subjects. UBOs are important in patients with

| Variable                                | Presence of focal lesion in CT | Absence of focal lesion in CT | P value |
|-----------------------------------------|--------------------------------|-------------------------------|---------|
| Category of age                          |                                |                               | 0.38    |
| 60 - 70 years                            | 70 (71.4)                      | 70 (68.0)                     |         |
| 70 - 80 years                            | 20 (20.4)                      | 28 (27.2)                     |         |
| >80 years                                | 8 (8.2)                        | 5 (4.9)                       |         |
| Gender                                   |                                |                               | 0.35    |
| Male                                     | 67 (68.4)                      | 64 (62.1)                     |         |
| Female                                   | 31 (31.6)                      | 39 (37.9)                     |         |
| Seizure type                             |                                |                               | 0.00    |
| GTCS                                     | 20 (20.4)                      | 41 (39.8)                     |         |
| SPS                                      | 65 (66.3)                      | 19 (18.4)                     |         |
| CPS                                      | 13 (13.3)                      | 42 (40.8)                     |         |
| Myoclonic seizure                        | 0                              | 1 (1.0)                       |         |
| Secondary generalization                 |                                |                               | 0.00    |
| No generalization                        | 15 (19.2)                      | 40 (65.6)                     |         |
| SPS with generalization                  | 58 (74.4)                      | 9 (14.8)                      |         |
| CPS with generalization                  | 5 (6.4)                        | 19 (19.7)                     |         |
| Cluster attacks                          | 25 (25.5)                      | 28 (27.2)                     | 0.78    |
| Status epilepticus                       | 20 (20.4)                      | 14 (13.6)                     | 0.19    |
| Response of SE                           |                                |                               | 0.39    |
| Controlled                               | 13 (65.0)                      | 11 (78.6)                     |         |
| Uncontrolled                             | 7 (35.0)                       | 3 (21.4)                      |         |
| Past H/O stroke                          | 14 (14.3)                      | 5 (4.9)                       | 0.02    |
| Focal deficits                           | 29 (29.6)                      | 5 (4.9)                       | 0.00    |
| Diffuse edema (CT)                       | 10 (10.2)                      | 11 (10.7)                     | 0.91    |
| Cerebral atrophy (CT)                    | 59 (60.2)                      | 80 (77.7)                     | 0.00    |
| Grade of atrophy (CT)                    |                                |                               | 0.01    |
| Mild                                     | 38 (63.3)                      | 41 (51.3)                     |         |
| Moderate                                 | 11 (18.3)                      | 32 (40.0)                     |         |
| Severe                                   | 11 (18.3)                      | 7 (8.8)                       |         |
| Cerebral atrophy on (MRI)                | 15 (62.5)                      | 16 (84.2)                     | 0.11    |
| White Matter Changes (CT)                | 38 (38.8)                      | 37 (35.9)                     | 0.67    |
| White Matter Changes (MRI)               | 11 (45.8)                      | 9 (47.4)                      | 0.92    |
| UBOs on MRI                              | 4 (16.7)                       | 8 (42.1)                      | 0.06    |
| VR space prominence                      | 2 (8.3)                        | 5 (26.3)                      | 0.11    |
| Focal Lesions on MRI                     | 23 (95.8)                      | 1 (5.3)                       | 0.00    |
| Abnormal biochemistry                    | 16 (16.3)                      | 19 (18.4)                     | 0.69    |
| Abnormal LP CSF                          | 6 (50.0)                       | 3 (17.6)                      | 0.06    |
| Diffuse slowing on EEG                   | 31 (31.6)                      | 27 (26.2)                     | 0.39    |
| Focal slowing on EEG                     | 20 (20.4)                      | 6 (5.8)                       | 0.00    |
| Epilepsy syndrome                        |                                |                               | 0.00    |
| Cryptogenic + idiopathic                 | 6 (6.1)                        | 73 (70.9)                     |         |
| Acute symptomatic (provoked)             | 58 (59.2)                      | 27 (26.2)                     |         |
| Remote symptomatic                      | 34 (34.7)                      | 3 (2.9)                       |         |
| Seizure recurrence (unprovoked) at F/U   | 10 (23.8)                      | 5 (10.4)                      | 0.08    |
| Death                                    | 9 (100.0)                      | 4 (100.0)                     |         |
| Duration of Post-ictal state (Hours)     | 10.8                           | 4.5                            | 0.01    |
| GCS score                                | 13.2                           | 14.0                           | 0.02    |
Table 3: Comparative analysis between patients with and without focal lesions on MRI

| Variable                        | Presence of focal lesion | Absence of focal lesion | P value |
|---------------------------------|--------------------------|-------------------------|---------|
| Category of age                  |                          |                         |         |
| 60 - 70 years (n = 34)           | 19 (79.2)                | 15 (78.9)               |         |
| 70 - 80 years (n = 8)            | 4 (16.7)                 | 4 (21.1)                |         |
| >80 years (n = 1)                | 1 (4.2)                  | 0                       |         |
| Gender                          |                          |                         |         |
| Male (n = 31)                    | 15 (62.5)                | 16 (84.2)               | 0.02    |
| Female (n = 12)                  | 9 (37.5)                 | 3 (15.8)                |         |
| Seizure semiology               |                          |                         |         |
| GTCS (n = 3)                     | 2 (8.3)                  | 1 (5.3)                 |         |
| SPS (n = 19)                     | 15 (62.5)                | 4 (21.1)                |         |
| CPS (n = 20)                     | 7 (29.2)                 | 13 (68.4)               |         |
| Myoclonic seizure (n = 1)        | 0                        | 1 (5.3)                 |         |
| Secondary generalization        |                          |                         | 0.03    |
| No generalization (n = 18)       | 7 (31.8)                 | 11 (64.7)               |         |
| SPS with generalization (n = 16) | 13 (59.1)                | 3 (17.6)                |         |
| CPS with generalization (n = 5)  | 2 (9.1)                  | 3 (17.6)                |         |
| Past H/O stroke (n = 4)          | 0                        | 0                       | 0.06    |
| Motor deficits (Limb weakness)   | 10 (41.7)                | 1 (5.3)                 | 0.00    |
| Focal Lesions on CT (n = 24)     | 23 (95.8)                | 1 (5.3)                 | 0.00    |
| EEG diagnosis                    |                          |                         | 0.05    |
| Normal EEG (n = 18)              | 7 (29.2)                 | 11 (57.9)               |         |
| Abnormal EEG (n = 25)            | 17 (70.8)                | 8 (42.1)                |         |
| Diffuse slowing on EEG (n = 13)  | 6 (25.0)                 | 7 (36.8)                | 0.40    |
| Focal slowing on EEG (n = 7)     | 7 (29.2)                 | 0                       | 0.01    |
| Reason for changing AEDs at F/U  |                          |                         | 0.01    |
| Inadequate seizure control (n = 5)| 4 (100.0)               | 1 (20.0)                |         |
| Adverse drug effects (n = 4)     | 0                        | 4 (80.0)                |         |
| Epilepsy syndrome                |                          |                         | 0.00    |
| Cryptogenic (n = 19)             | 4 (16.7)                 | 15 (78.9)               |         |
| Symptomatic (n = 24)             | 20 (83.3)                | 4 (21.1)                |         |
| Seizure recurrence (unprovoked)  | 4 (30.8)                 | 3 (25.0)                | 0.74    |
| Death (n = 3)                    | 2                        | 1                       |         |

Table 4: Final etiological diagnosis in patients with unprovoked and provoked seizures

| Underlying etiology                | Unprovoked (remote symptomatic, cryptogenic, idiopathic) | Provoked (acute symptomatic) | Total |
|------------------------------------|--------------------------------------------------------|------------------------------|-------|
| Cryptogenic                        | 79                                                     | 0                            | 79    |
| Old arterial infarct               | 26                                                     | 0                            | 26    |
| Metabolic encephalopathy           | 0                                                      | 25                           | 25    |
| Acute arterial infarct             | 0                                                      | 18                           | 18    |
| Acute intracerebral hemorrhage     | 0                                                      | 12                           | 12    |
| Brain tumor                        | 0                                                      | 10                           | 10    |
| Meningoencephalitis                | 0                                                      | 6                            | 6     |
| Cysticercal granuloma              | 4                                                      | 2                            | 6     |
| Brain Metastases                   | 1                                                      | 1                            | 2     |
| Post-traumatic epilepsy            | 3                                                      | 0                            | 3     |
| Cerebral venous thrombosis         | 0                                                      | 3                            | 3     |
| Systemic malignancy                | 2                                                      | 0                            | 2     |
| Cerebral Amyloid Angiopathy        | 0                                                      | 2                            | 2     |
| Alcohol related seizures           | 0                                                      | 2                            | 2     |
| Old hemorrhage                     | 1                                                      | 0                            | 1     |
| Dementia                           | 1                                                      | 0                            | 1     |
| Rasmussen’s encephalitis           | 1                                                      | 0                            | 1     |
| Fungal granuloma                   | 0                                                      | 1                            | 1     |
| Dementia + Metabolic encephalopathy| 0                                                      | 1                            | 1     |
seizures as they may mimic or obscure acute infarcts and small neoplastic masses. The relationship of VR spaces and epilepsy has not been documented. Moreover, comparison of these observations with those in control population was not carried out. Another shortcoming could be lack of MRI in all patients, thereby limiting the interpretation, and some of the cryptogenic group could be symptomatic. Moreover, some of newer MR sequences were not carried out, thereby underestimating the abnormalities.

This study reiterates the importance of neuroimaging in elderly patients with new onset seizures. The relationship with leukoaraiosis, cerebral atrophy, UBOs, prominent white matter changes require further in-depth analysis and longitudinal assessment.

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