

# A Prospective Study of Seizures in Patients with Stroke

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## Abstract

**Introduction:** Stroke is one of the most common causes of seizures in the elderly and seizures are among the most common neurological sequelae of stroke. Seizures can occur at the onset or may follow strokes.

**Aim:** The aim is to study the time of onset, semiology of seizure, and occurrence of seizure in relation to the type of stroke.

**Materials and Methods:** Patients aged above 16 years presenting with seizures associated with stroke were included in this study.

**Results:** Early-onset seizures were present in 64 patients and late-onset in 36 patients. 63 patients presented with partial seizure, 35 patients presented with generalized seizures, and 2 with status epilepticus.

**Conclusion:** Partial seizures are common in stroke-related seizures than generalized tonic-clonic seizures, complex partial seizures being the rarest presentation. Early-onset seizure (seizures within 2 weeks of stroke) is the most common type of stroke-related seizure.

**Key words:** Management, Seizure, Stroke

## INTRODUCTION

Stroke is one of the most common causes of seizures in the elderly and seizures are among the most common neurological sequelae of stroke. Seizures can occur at the onset or may follow strokes. Approximately 10% of patients with stroke had seizures at some time after their stroke. In the seizures after stroke study, a prospective, multicenter study conducted among university hospitals in Canada, Israel, Italy, and Australia, 8.3% of stroke patients had seizures.<sup>1</sup> In this series, more than half of the seizures occurred on the 1<sup>st</sup> day of stroke. 80% of seizures occurred by the 1<sup>st</sup> month. Patients with cardioembolic infarcts,

have a much higher frequency seizures, than those with large artery occlusive infarcts. In supratentorial infarcts, patients with cardioembolic stroke had a relative risk of 5.14 of developing early seizures than in patients non-cardiac origin embolic stroke.<sup>2</sup> Previous studies suggesting a relationship between cardiac embolism and seizures were observational and were performed before the availability of modern imaging techniques. The occurrence of seizures at the onset of stroke has been well established.<sup>3</sup> The frequency had varied between 2% and 18% depending on the study and stroke type. In a large-scale autopsy study, 13.8% of patients with intracerebral hemorrhage suffered seizures at the onset of stroke compared to 7% in the ischemic stroke.<sup>4</sup> Superficial cortical lesion is more likely to precipitate seizures at the onset of stroke. Data regarding the subtype of seizure (simple partial, complex partial, partial with secondary generalization, or generalized tonic-clonic) in studies are limited by the retrospective design of most of the studies and are potentially confounded by the interviewer and recall bias. Up to 63% of seizures may not be recognized by the patients.<sup>5</sup> Approximately 50-90%

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of early-onset seizures are simple partial seizure.<sup>1,6-8</sup> In contrast, one study reported higher frequency (50%) of generalized tonic-clonic seizures (GTCS) without focal onset in early-onset seizures.<sup>9</sup> Status epilepticus is a life-threatening complication of stroke. Stroke accounts for 25% of cases of status epilepticus in few series. A hospital-based study found that 0.14% of patients with ischemic or hemorrhagic strokes had developed status epilepticus. Differences in the study design, definition of late or early seizures, target population, inclusion and exclusion criteria, and data on imaging limit a direct stroke-related seizures are a neglected topic and generally considered as a benign complication occurring in the course of a progressive and long-standing cerebrovascular disease. Comparison of the seizures and may explain the contradictory results in the literature.

### Aim

The aim is to study the time of onset, semiology of seizure, and occurrence of seizure in relation to the type of stroke.

## MATERIALS AND METHODS

This prospective, observational study conducted in the Department of Neurology, Tirunelveli Medical College and Hospital, Tirunelveli, Tamil Nadu, India. Patients aged above 16 years presenting with seizures associated with stroke were included in this study. Exclusion criteria: Children and adolescents <16 years of age, patients with a history of seizures before the occurrence of stroke, stroke-like presentation due to neurosurgical causes such as arteriovenous malformation, tumor, trauma and brain abscess, acute and chronic central nervous system infections manifesting as arteritis, patients with cortical venous thrombosis and venous stroke, stroke due to drug addiction and substance abuse, post-cardiac arrest resuscitation state, seizures associated with stroke as a sequelae of pregnancy-related complications, and unwilling and non-cooperative patients. All the patients in this study group were evaluated by complete medical history, neurological examination, and routine baseline investigations. Axial computed tomography (CT), interictal electroencephalography (EEG), and 1.5 magnetic resonance imaging (MRI) brain were done in all patients.

## RESULTS

A total of 100 patients were included in this study, of which 76 were male and 24 were female. The sex ratio was male:female (3.2:1) (Figure 1).

The maximum number of patients ( $n = 31$ ) was from the age group (61-70 years) showing that the elder age group

prone for the development of stroke-related seizures Table 1.

Of the 100 patients, 68 had ischemic stroke and 32 had intracerebral hemorrhage as evidenced by the neuroimaging studies. Of the 68 ischemic stroke group, 12 had demonstrable cardiac source of emboli evidenced by the echocardiogram. Remaining 56 patients in the ischemic stroke group were considered to have probable thrombotic etiology.

Early-onset seizures were present in 64 patients and late-onset in 36 patients. Of the 64 patients with early-onset seizure, 50 patients (78%) had immediate onset of seizures (i.e.) within the first 24 h of stroke. Of the early-onset group, cardioembolic stroke was present in 8 and thrombotic stroke was present in 36 patients. Intracerebral hemorrhage was present in 20 patients. Of the late-onset seizure group ( $n = 36$ ), 4 had cardioembolic stroke, 20 had thrombotic, and 12 had intracerebral hemorrhage (Tables 2 and 3).

In this study, 63 patients presented with partial seizure, 35 patients presented with generalized seizures, and 2 with status epilepticus (Table 4).

Among the partial seizure subgroup ( $n = 63$ ), 35 had simple partial seizures (56%) and 27 (42.5%) had partial seizure

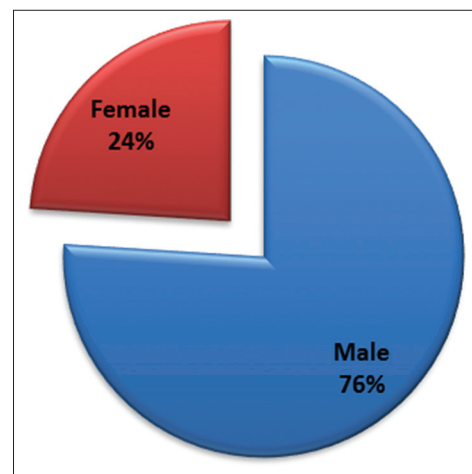


Figure 1: Distribution of gender in study patients

Table 1: Seizures in relation to age

Age group in years	Number of cases
21-30	4
31-40	13
41-50	17
51-60	26
61-70	31
Above 70	9

with secondary generalization. One patient had complex partial seizure (1.5%) (Table 5).

Interictal EEG was done in 75 patients only. The EEG of all the patients presenting with seizures associated with stroke was categorized into 5 types as given in Table 6.

## DISCUSSION

A total of 100 patients presenting with seizures associated with arterial stroke were included in this study. In this study, maximum number of post-stroke seizures ( $n = 31$ ) occurred in the age group between 61 and 70. The study by Forsgren *et al.*<sup>10</sup> observed that stroke accounts for 30% of the newly diagnosed seizures in patients more than 60 years old. Hauser *et al.* in their community-based study conducted at Rochester, USA also observed a similar

**Table 2: Timing of seizures**

Timing of seizures	Number of patients
Early-onset	64
Late-onset	36

**Table 3: Distribution of seizures according to the timing of seizures and stroke subtype**

Type of stroke	Early-onset seizure	Late-onset seizure
Thrombotic	36	20
Hemorrhagic	20	12
Embolic	8	4

**Table 4: Seizure semiology associated with stroke**

Seizure pattern	Number of patients
Partial seizure	63
Generalized	35
Status epilepticus	2

**Table 5: Distribution of type of seizure**

Type of seizure	Number of patients
Simple partial	35
Partial with secondary generalization	27
Complex partial	1

**Table 6: Distribution of EEG findings**

Type patients	Number of patients (%)
Type I - Normal	15 (20)
Type II - Diffuse slowing	7 (9)
Type III - Focal slowing with/without diffuse slowing	36 (48)
Type IV - Focal spikes, sharpwaves	15 (20)
Type V - Presence of PLEDS	2 (3)

EEG: Electroencephalography, PLEDS: Periodic lateralized epileptiform discharges

trend in the age-specific incidence of post-stroke seizures. Hence, it is obvious from the present study and the above studies that the post-stroke seizures are more common in the elder age group.

Of the total 100 patients of seizures with stroke, 56 patients had ischemic stroke as evident from the CT brain or MRI brain. 32 patients presented with hemorrhagic stroke and 12 patients had embolic stroke mostly cardioembolic as evidenced by echocardiogram. The incidence of seizures was 10.6 in patients with hemorrhagic stroke and 8.6 with ischemic stroke as studied by Bladin *et al.*<sup>1</sup>

This study reported the semiology of seizures as follows: Partial seizures - 63%, generalized seizures - 35%, and status epilepticus - 2%. Of the partial seizure type, 56% had simple partial seizures, 42.5% had partial seizures with secondary generalization. One patient (1.5%) reported complex partial seizure with a sense of fear as the presenting aura.

Several studies (Bladin *et al.*, Lamy *et al.*, Kilpatrick *et al.*, and Giroud *et al.*) report approximately 50-90% of early-onset seizures as simple partial seizures.<sup>1,6-8</sup>

In contrast, the study of the prognostic value of early seizures in stroke by Arboix *et al.* reported a higher frequency (50%) of generalized seizures without focal onset in patients with early-onset seizures.<sup>9</sup>

In a study of early-onset seizures in 90 patients by Giroud *et al.*, simple partial seizures were the most common type (61%) followed by focal onset seizures with secondary generalization (28%).<sup>8</sup>

In another series by Davalos *et al.* and Gupta *et al.*, early-onset seizures were more likely to be partial and late-onset seizures were more prone for secondary generalization.<sup>11,12</sup>

In an Indian study by Dhanuka *et al.*, 78.6% of single initial seizure was focal, whereas 21.4% had generalized seizures. Focal seizures were the predominate type of seizures in early-onset (74%) and late-onset (75%) group.<sup>13</sup>

Stroke accounts for 25% of cases of status epilepticus in some series.<sup>14</sup> The present study reported 2% cases of status epilepticus. A single institution study by Rumbach *et al.* found that 22 of 2742 patients with ischemic stroke (0.8%) had status epilepticus.<sup>15</sup> In a large study of post-stroke seizures, 9% had status epilepticus.<sup>16</sup> It also observed that status epilepticus was not associated with higher mortality, stroke type (ischemic or hemorrhagic), topography (cortical involvement) or lesion size, or EEG patterns.

It is evident from all these studies and the present study except for very few studies, partial seizures are the most common seizure type in stroke. Data regarding the seizure subtype vary with different studies. This is because several studies of post-stroke seizure are limited by the retrospective design in majority of the studies and are potentially confounded by recall bias and interviewer bias related to obtaining the description of seizure from observers (or) patients. Up to 63% of seizures may not be recognized by patients.<sup>5</sup> Hence, it is not surprising that different studies find varying frequencies of seizure subtype after stroke.

The most common EEG abnormality observed in the present study was focal slowing (Type III) present in 48%. Similar correlation was observed in few studies (Gupta *et al.*, Dhanuka *et al.*). In this study, periodic lateralized epileptiform discharges were seen only in 3%.<sup>12,13</sup>

EEG findings were correlated with recurrent seizures (discussed later). No specific EEG pattern was associated with early versus late seizures or recurrent seizures in post-stroke seizures as per the prospective study by Dhanuka *et al.* Hence, the author states that the prognostic value of EEG is of little importance.<sup>13</sup>

## CONCLUSION

Partial seizures are common in stroke-related seizures than GTCS, complex partial seizures being the rarest presentation. Early-onset seizure (seizures within 2 weeks of stroke) is the most common type of stroke-related seizure. Much additional work is needed to better understand the social impact of post-stroke seizures, their prevention, and effective management. Areas of the future research regarding seizures in stroke include assessing the delayed

patient outcomes and developing newer antiepileptic drugs with more neuroprotective effects.

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