

SEMIOLOGICAL ANALYSIS AS AN ALTERNATIVE FOR SEIZURE FOCUS LOCALIZATION IN FOCAL IMPAIRED AWARENESS SEIZURE PATIENTS IN A TERTIARY CARE HOSPITAL OF WEST BENGAL

Sankhapani Mishra¹, Krishnachura Mitra¹, Shuvojyoti Rakshit², Maumita Das³

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Corresponding Author:

Dr. Krishnachura Mitra,

Email: dr.krishnachuramitra@gmail.com

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¹Associate Professor, Department of Physiology, R. G. Kar Medical College, Kolkata, West Bengal, India

²Intern, N.R.S. Medical College, Kolkata, India

³Assistant Professor, Department of Physiology, Bankura Sammilani Medical College, Bankura, West Bengal, India

ABSTRACT

Background: The latest ILAE classification defines Focal onset seizures as an episodic epileptiform seizure with abnormal foci of excessive neural activity, which is limited to the neuronal network of one hemisphere only. Semiological analysis is important in Focal Impaired Awareness Seizures (previously called Complex Partial Seizures) as it is not preceded by a structural lesion that can be diagnosed easily by radiological modalities. If untreated and undiagnosed, this may progress to bilateral tonic-clonic seizures. **Aims and Objectives:** To compare the effectiveness of semiology-based interpretation with imaging modalities for localization in Focal Impaired Awareness Seizures and to find out the lateralization ability of semiological investigation in conjunction with imaging modalities. **Methodology:** The study was conducted on 46 patients of Focal Impaired Awareness Seizures attending the OPD of an epileptic clinic of a tertiary care hospital. A detailed history of aura, ictal, and postictal phenomenon was taken and compared with the available reports, EEG and imaging data for semiological localization. In the patients who were imaging-positive, lateralization was studied using both semiology and imaging findings. **Observation and Result:** Analysing the semiological findings and radiological findings, Temporal Lobe Seizure was found to be the most common (66%). Among the lateralized cases, both semiology and radiological findings showed the hemispheric distribution was nearly equal, with 16 cases (52%) originating from the left hemisphere and 15 cases (48%) from the right hemisphere. **Conclusion:** In this study, a considerably similar finding in the localization of seizure foci between semiology and imaging findings was found and in fact the study showed comparatively better results from semiology to some extent.

INTRODUCTION

The latest ILAE classification defines Focal onset seizures as an episodic epileptiform seizure with abnormal foci of excessive neural activity, which is limited to the neuronal network of one hemisphere only.^[1] Focal Impaired Awareness Seizures (previously called Complex Partial Seizures) particularly prove to be a diagnostic and therapeutic challenge, considering unlike Focal aware seizures, it does not precede by a structural lesion that can be diagnosed easily by radiological modalities.^[2] Furthermore, if untreated and undiagnosed, this may progress from focal to bilateral tonic-clonic seizures.^[3] Due to the nature of focal onset seizure to affect any particular lobe, the clinical features and

progression of the disease may vary widely. Such as, focal seizure with frontal lobe origin has a higher predisposition to turn into generalized seizure more than any other lobe,^[4-6] whereas mesial temporal lobe seizure may present with hippocampal sclerosis and has a lesser chance of progression to generalized seizure compared to lateral temporal origin.^[3,5,7] Despite the varied presentation of focal seizures, only a few show any characteristic changes in imaging modalities, and seizures originating from the Insular lobe can't be detected accurately with EEG, either.^[8,9] Semiological studies, comprising a detailed history of signs and symptoms during the pre-ictal, ictal, and post-ictal stages, show a possible alternative in bedside diagnosis for the affected lobe in focal onset seizures.

According to NIH's survey, considering the 1% prevalence of epilepsy in India, almost 12 million people suffer from it, and many of them start from focal onset seizure, which progresses to generalized seizure later on.^[10] In the resource-poor setup of the Indian healthcare system, semiology has a higher application in diagnosis compared to MRI or EEG studies and in cases where imaging finding may not be sufficient enough to localise the lesion, semiology still can give important clinical clue towards diagnosis. Despite that, very few studies have been done in the assessment of the effectivity of semiology-based diagnosis of focal onset seizures with or without in association with imaging modalities in eastern India. Our study aims to compare the effectiveness of semiology-based interpretation for localization with imaging modalities and illustrates the lateralization ability of semiological investigation in conjunction with imaging modalities in Indian patients of focal onset seizures.

MATERIALS AND METHODS

The study was conducted at an outpatient department of epilepsy clinic of a tertiary care hospital. With the prevalence of 4.3% of focal impaired awareness seizure, the sample size with 80% power was calculated to be 12, which was exceeded by taking 46 cases in the study duration of 6 months.^[10] All the included patients were diagnosed with cases of focal onset seizure with impaired awareness and have undergone at least more than 1 episode of convulsion with impaired awareness. A detailed history of aura, ictal, and post ictal phenomenon was taken from consenting patients and their caregivers. From available reports, EEG and imaging data are obtained and compared with semiological localization. In the patients who were imaging-positive, lateralization was studied using both semiology and imaging findings.

RESULTS

Among the 46 cases of focal seizures analyzed, Focal Impaired Awareness Seizures were the most common, observed in 29 cases (63%). The remaining 17 cases (37%) involved Focal Impaired Awareness Seizures with secondary generalization.

Table 1: Different Types of Focal Seizure

Type of Seizure	Number	Proportion (%)	P value
Focal Impaired Awareness Seizures	29	63	0.07
Focal Impaired Awareness Seizures with Secondary Generalization	17	37	

Focal seizures occurred across all age groups. The highest proportion was seen in the 0–10 year age group, with 17 cases (37%), followed closely by the 11–20 year age group, which accounted for 15 cases

(33%). The lowest proportion was noted in the 21–40 year groups, each with 4 cases (9%). In individuals older than 40, seizures were observed in 6 cases (12%).

Table 2: Proportion of Focal Seizures in Different Age Groups

Age Group (Years)	Number	Proportion (%)	P Value
0–10	17	37	0.7
11–20	15	33	
21–30	4	9	
31–40	4	9	
>40	6	12	

The sex distribution among the 46 cases was almost equal. Males constituted 52% of the cases (24

patients), and females made up 48% (22 patients), indicating no significant sex predisposition.

Table 3: Sex of 46 Subjects with Focal Seizure

Sex	Number	Proportion (%)	P Value
Male	24	52	0.087
Female	22	48	

A positive family history of seizures was reported in 7 cases (15%), while the majority (39 cases, 85%) had no family history of seizures, indicating that

familial predisposition played a relatively minor role in this cohort.

Table 4: Family History in 46 Cases of Focal Seizure

Family History	Number	Proportion (%)	P Value
Positive	7	15	0.7
Negative	39	85	

Birth trauma was identified as a potential contributing factor in 11 cases (24%), while the remaining 35 cases (76%) had no history of birth

trauma, suggesting that other causes may predominate in this population.

Table 5: Birth Trauma in 46 Cases of Focal Seizure

Birth Trauma	Number	Proportion (%)	P Value
Positive	11	24	* <0.05
Negative	35	76	

EEG findings were abnormal in 41 cases (89%), supporting the diagnosis and localization of epileptogenic foci. However, 5 cases (11%) had

normal EEG results, which suggests that EEG may not always capture epileptiform activity.

Table 6: EEG Findings in 46 Cases of Focal Seizure

EEG Findings	Number	Proportion (%)	P Value
Positive	41	89	* <0.05
Normal	5	11	

Radiological imaging (CT/MRI) revealed abnormalities in 35 cases (76%), contributing to the

localization of the seizure focus. In contrast, 11 cases (24%) had normal imaging results.

Table 7: CT/MRI Findings in 46 Cases of Focal Seizure

CT/MRI Findings	Number	Proportion (%)	P Value
Positive	35	76	* <0.05
Normal	11	24	

The causes of focal onset seizures were diverse. Idiopathic and congenital causes were the most common, each accounting for 9 cases (20%). Degenerative conditions also contributed to 9 cases

(20%), followed by traumatic causes in 6 cases (13%). Neoplastic, infective, and vascular causes were identified in smaller proportions, as shown in the table below.

Table 8: Causes of Seizure in 46 Cases of Focal Seizure

Causes	Number	Proportion (%)	P Value
Idiopathic	9	20	* <0.05
Congenital	9	20	
Vascular	2	4	
Neoplastic	5	10	
Degenerative	9	20	
Infective	4	9	
Traumatic	6	13	
Others	2	4	

Aura was present in 37 cases (80%) and absent in 9 cases (20%) among the 46 cases of focal onset

seizures. Aura analysis is significant for localizing the origin of the seizures.

Table 9: Aura in 46 Cases of Focal Seizure

Aura	Number	Proportion (%)	P Value
Positive	37	80	* <0.05
Negative	9	20	

The types of auras observed among the 37 cases were categorized and their proportions were analyzed. Motor auras were the most common, observed in 22 cases (59%), while cognitive symptomatology such as jamais vu was the least common, found in 1 case

(3%). Other types of auras included sensory (tingling), visual, automatic, psychomotor, and affective symptomatology (intense fear), as summarized in [Table 10].

Table 10: Types of Aura with Descriptions and Case Count

Type of Aura	Description	Number of Cases	Proportion (%)	P Value
Motor Aura	Head turning to the right (7 cases) and left (8 cases), indicating motor involvement.	15	59	* <0.05
	Early non-forceful deviation of head to the left (2 cases) and right (1 case).	3		
	Deviation of the angle of the mouth to the left.	1		
	Eye deviation to the left (1 case) and right (2 cases).	3		
Sensory Aura	Tingling sensation, suggestive of sensory involvement.	4	11	

Visual Aura	Visual blackening, blurring of vision, with or without headache.	6	16	
Automatic Aura	Abdominal discomfort or rising epigastric sensation.	5	14	
Affective Aura	Intense fear sensation.	4	11	
Cognitive Aura	Jamais vu phenomenon, a rare cognitive disturbance.	1	3	
Psychomotor Aura	Oroalimentary automatisms such as lip smacking.	4	11	
	Eye blinking observed in 1 case.	1		

Note: Some cases exhibited more than one type of aura; therefore, percentages do not add up to 100%.

Loss of consciousness or transient inability to maintain contact with the environment occurred in almost all cases of focal impaired awareness seizure.

Specific ictal phenomena other than loss of consciousness were noted in isolated cases, as shown in [Table 10A].

Table 10A: Ictal Phenomena

Ictal Phenomenon	Number	Proportion (%)
Ictal laughter	1	2
Ictal spitting	1	2
Ictal vomiting	1	2
Ictal speech arrest	1	2

Post-ictal symptoms were documented in a subset of patients. These included confusion, vomiting,

weakness (Todd's paresis), and headache [Table 10B].

Table 10B: Post-Ictal Phenomena

Post-Ictal Phenomenon	Number
Post-ictal confusion	4
Post-ictal vomiting	1
Weakness (Todd's paresis)	1
Post-ictal headache	1

The semiology and radiological findings were analyzed to identify the seizure origin in the lobes of the brain. Temporal lobe seizures were the most common, observed in 30 cases (66%), followed by

frontal lobe seizures in 12 cases (26%). Parietal and occipital lobe origins were rare, with each identified in 2 cases (4%) [Table 11].

Table 11: Lobe of Origin of Seizures

Lobe of Origin	Number	Proportion (%)	P Value
Temporal	30	66	* <0.05
Frontal	12	26	
Parietal	2	4	
Occipital	2	4	

In 31 out of 36 cases, lateralization of seizure origin was possible (86%), while in 5 cases (14%), lateralization could not be established [Table 12]. Among the lateralized cases, the hemispheric

distribution was nearly equal, with 16 cases (52%) originating from the left hemisphere and 15 cases (48%) from the right hemisphere [Table 13].

Table 12: Lateralization of Seizure Origin

Lateralization	Number	Proportion (%)	P Value
Possible	31	86	* <0.05
Not Possible	5	14	

Table 13: Hemispheric Origin of Seizures

Hemisphere	Number	Proportion (%)	P Value
Right	15	48	* <0.05
Left	16	52	

Table 14: CT/MRI Findings vs Semiology

Lobe of Origin	Semiology Suggesting the Origin	CT/MRI Findings Suggesting the Origin	McNemar's Test Result (p-value)
Temporal	30	16	p = 0.002 (Significant)
Frontal	12	12	p = 1.0 (Not Significant)
Parietal	2	1	p = 0.317 (Not Significant)
Occipital	2	2	p = 1.0 (Not Significant)

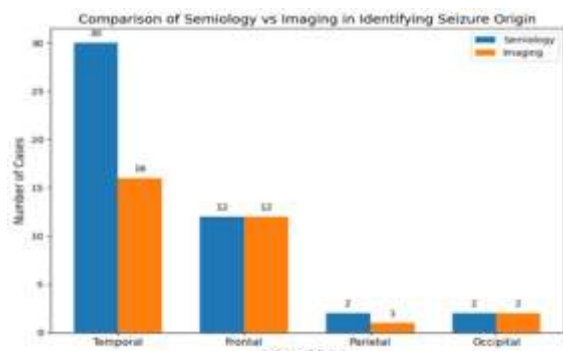


Figure 1: Stacked Bar Diagram showing a comparison between semiology and imaging in identifying seizure origin

The findings from CT/MRI were analyzed to confirm the semiology-based localization of seizures. Temporal lobe origin was indicated by semiology in 30 cases, but confirmed radiologically in 16 cases. Frontal lobe origin showed good agreement, with 12 cases supported by both semiology and radiology. Parietal and occipital lobes were less frequent but showed concordance in 1 and 2 cases, respectively [Table 14]. In 11 cases, CT/MRI findings were normal, and in 4 cases, the findings were insufficient for localization.

DISCUSSION

We conducted this study on 46 diagnosed cases of focal impaired awareness seizure, in which 37% had a history of secondary generalization, indirectly indicating a possible epileptic focus in the frontal lobe.^[4-6] Most patients were in the paediatric age group, with 70% under 20 years old and a male-to-female ratio of 1.07:1. In 15% of cases, there was a positive family history of seizures, and 24% had a history of birth trauma. In the EEG findings, while 41 cases showed positive diagnostic abnormality showing abnormal temporal spikes, 5 cases had normal EEG results, possibly due to the non-availability of ambulatory EEG monitoring or seizure origin in the insular lobe, which is notoriously difficult to detect in EEGs. Imaging modalities such as CT and MRI identified characteristic lesions in only 76% of cases, correlating with previous literature highlighting the absence of radiological findings in many cases of focal impaired awareness.^[8]

From the detailed histories collected from patients and their caregivers, we assessed pre-ictal auras, ictal phenomena, and post-ictal features. We compared these with existing literature to identify characteristic lobe-specific features. Aura, as described by Galen, the sensation of a breath of air experienced by some individuals prior to a seizure, is considered the phase of the seizure before losing consciousness.^[11] [Table 10] shows different types of auras, with the majority being motor auras. Among the motor auras, head turning to the right was observed in 7 cases and to the left in 7 cases, indicating contralateral motor

origin, while deviation of the angle of the mouth to the left in 1 case suggested contralateral involvement. Early non-forceful head deviation was found in 2 cases to the left and in 1 case to the right, signifying ipsilateral seizure origin. Eye deviation was observed to the left in 1 case and to the right in 2 cases, consistent with contralateral origin. Tonic bilateral posturing was noted in 3 cases, lacking lateralizing value. In contrast, tonic posturing of the left side and right side, each observed in 1 case, indicated contralateral origin. A fixed stooping posture and fencing posture, both observed in 1 case, suggested frontal lobe involvement. Sensory auras in the form of tingling sensations were reported in 4 cases, indicative of parietal lobe origin, while visual auras, such as visual blackening or blurring of vision with or without headache, were found in 6 cases, pointing to occipital lobe origin. Abdominal discomfort or rising epigastric sensations, common auras, occurred in 5 cases and indicated inferomesial temporal lobe origin. Fear, a limbic aura considered amygdaloid in origin, was noted in 4 cases. Oroalimentary automatism, such as lip smacking, was observed in 4 cases, suggesting temporal lobe origin, while eye blinking was reported in 1 case, indicating occipital lobe involvement. Cognitive auras like jamais vu were seen in 1 case, suggesting lateral temporal lobe origin, while complex automatism was noted in a case where a patient performed a shaving action without awareness, indicating right lateral temporal lobe involvement. In one complex semiology, an abnormal hallucinatory taste was followed by rising epigastric sensation, head and eye deviation, and clonic movement of the thumb, where each symptom alone could point to different seizure foci, such as the dorsolateral motor neocortex, contralateral premotor cortex, inferomesial temporal lobe, or the suprasylvian inferior Rolandic cortex. The localization of epileptic foci is often guided by functional or "eloquent" cortex, in contrast to "silent" cortex areas that lack clear function; however, even when silent cortex is involved, it is often near functional regions, allowing clinical localization of seizure origins.

Among ictal phenomena, ictal laughter occurred in 1 case, suggesting an origin in the hypothalamic, mesial temporal, or cingulate gyrus regions. Ictal spitting or vomiting was noted in 2 cases, indicating involvement of the right temporal lobe, while ictal speech arrest was observed in 1 case, indicating an origin in the dominant hemisphere.

In post-ictal phenomena, post-ictal confusion and post-ictal vomiting both point towards temporal lobe seizures, where seizures originating from the insular cortex can also present with nausea and vomiting. Todd's paresis is seen on the contralateral side of lobe origin, and post-ictal headache is observed in some cases of occipital lobe seizure.^[12-14]

Comparing the localization findings between semiology and imaging, as shown in Figure 1 and [Table 14], while both indicated temporal lobe seizures as predominant, there was a statistically

significant difference ($p=0.002$) in the number of positive cases. Although hippocampal sclerosis is one of the most commonly observed radiological changes in temporal lobe seizures, the inability to accurately localize radiologically may have resulted in false-negative results, causing discrepancies. In cases involving other lobes, semiology and imaging findings did not show any significant statistical difference ($p>0.05$) in localization.

In the imaging-positive cases, lateralization was possible in 86% of cases where imaging and semiology showed similar evidence, but in 5 cases, semiology did not agree with the imaging result, which can be explained by epileptic foci originating in silent cortex.

CONCLUSION

Focal impaired awareness seizure presents a diagnostic challenge due to the absence of any structural abnormalities. It is only through a skilled radiologist's meticulous observation that some changes may be detected. In India's resource-limited healthcare setting, where access to radiological investigations like MRI is unavailable or behind a long wait time, a semiological approach based on detailed bedside history-taking may serve as a practical and accessible alternative. In our study, we observed a considerably similar finding in the localization of seizure foci between semiology and imaging findings, in fact showing comparatively better results from semiology to some extent. Though this study had several limitations from not having videographic of seizure episode to a more diverse study subject, this study still holds a place for demonstrating semiological application in seizure localization.

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