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Evaluating the Role of MRI in Uncovering Etiologies of New Onset Seizures in Adult: A Prospective Study from Tertiary Care Hospital

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ABSTRACT

Background: New-onset seizures in adults are a common neurological emergency, and Magnetic Resonance Imaging (MRI) is crucial in determining their etiology.
Methods: This descriptive cross-sectional analysis was performed at the Dow Institute of Radiology, DUHS, Karachi, between January and June 2025, and involved 279 adult patients aged 18–65 years who had first-time seizures. Standardized seizure-protocol brain MRI was performed on all patients and reviewed independently by two consultant radiologists. The results were collected and analysed descriptively and with chi-square statistics in SPSS-25 for age, gender, seizure type and MRI-detected aetiologies.
Results: The mean age was 41.0 ± 11.4 years, and 165 (59.1%) participants were men. A causative MRI finding was present in 101 (36.2%) patients. CNS infection was the commonest aetiology in 27 (9.7%), followed by infarct in 23 (8.2%), post-traumatic gliosis in 18 (6.5%) and neoplastic lesions in 17 (6.1%). Causative findings showed insignificant association with age group or gender (p>0.05).
Conclusion: A treatable structural abnormality was detected on MRI in a substantial minority of adults with new-onset seizures, with infective and vascular lesions predominating. The absence of meaningful variation in findings across age and gender groups supports a low threshold for MRI in all adults with a first seizure, irrespective of demographic characteristics.

Keywords: New onset Seizures, magnetic resonance imaging, adult epilepsy, neuroimaging, stroke, infectious etiologies neoplastic lesions.

INTRODUCTION

A seizure is an abrupt alteration of cerebral function resulting from excessive, synchronous and disorganised electrical activity of the cerebral cortex, which is an abnormal discharge of the brain's nerve cells, and may occur in the form of a change in consciousness, behaviour, sensation or motor activity.[1] They are a common feature of the general population, and about eight to ten per cent of people will have at least one seizure during their lifetime, but only a few of them will develop known epilepsy.[2] Most of these episodes are acute symptomatic episodes, triggered by a specific insult, not an epileptic tendency.[3] The first seizure is always a frightening event for the person experiencing it, the witnessing bystander and family, and the assessment of the first seizure is a repeated problem in everyday clinical practice.[4] New-onset seizures represent an essential cause for emergency department visits and a significant proportion of acute neurological presentations, with a significant proportion of these being first-ever seizures.[5] Seizures that occur after childhood should be carefully investigated because they are much more likely to be caused by a structural or systemic lesion such as a cerebral trauma, infection of the central nervous system (CNS), an intracranial space-occupying lesion, or a cerebrovascular accident (CVA).[6] The underlying aetiology is therefore a major management focus in adults, as the management is distinct from that of younger patients and often targeted at the underlying cause of the disorder itself.[7,8] Tertiary care centres have also confirmed that head trauma is the leading cause of seizures in adults, with cerebral tumours and stroke being the next most common causes, highlighting the importance of correct aetiological classification in the diagnosis of adult seizures.[9]

MRI has an established role in evaluating patients with a new-onset seizure, its superior soft-tissue contrast allowing causative structural abnormalities to be delineated that might otherwise remain occult.[10] In addition to the detection of mass lesions and vascular insults, MRI is well suited to the detection of infective and inflammatory processes that can guide targeted antimicrobial and anti-inflammatory treatment and aid effective treatment planning.[11,12] Contemporary consensus recommendations endorse dedicated structural MRI for all patients with a new-onset seizure in the non-emergent setting, reflecting its established yield in revealing epileptogenic substrate and its prognostic relevance for seizure recurrence.[13]

This is a recognised diagnostic finding, but there is limited local data available regarding the frequency of this occurrence and the

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spectrum of causative MRI abnormalities in adults who present with new-onset seizures, and much of the available data is derived from populations with disease burden and aetiological patterns that are distinct from those seen here.[6,9] When CNS infections and structural lesions have a significant role, the region-specific characterisation of imaging findings is crucial for rapid intervention, to tailor the use of contrast-enhanced studies and to build the evidence base for the daily use of radiology.[14]

The aims of this study were to investigate the prevalence and potential causes of new-onset seizures in patients suspected of having new onset seizures on MRI and to determine which of these causes can be identified early and precisely in adults for further management.

METHODOLOGY

Study Design and Setting

This descriptive cross-sectional study was carried out after obtaining ethical approval from the institutional ERC (Ref. No. IRB-3673/DUHS, dated 31st December 2024), and written informed consent was secured from every participant. The study was conducted at the Department of Radiology, Dow University of Health Sciences, Karachi, over a period of 6 months from January 2025 till 30 June 2025. Consecutive non-probability sampling was employed to enrol adult patients between eighteen and sixty-five years of age, of either gender, who presented with a new-onset seizure and were referred for MRI of the brain.

A new-onset seizure denoted an episode of uncontrolled abnormal cerebral electrical activity producing a change in the level of consciousness, behaviour, memory or sensation experienced by the patient for the first time in life. Patients with previously diagnosed epilepsy, pregnant women and those with a cardiac pacemaker, a cochlear implant or any MRI-incompatible metallic prosthesis were not eligible, and the paediatric age group was likewise excluded.

The sample size was estimated using the W.H.O calculator, taking proportion of causative (potentially epileptogenic) MRI findings as (23%)16, 95% C.I, and a 5% absolute precision and yielded a minimum required sample of 279 patients were enrolled during the study period. A structured questionare was used to record demographic details comprising age and gender together with history of the seizure episodes, including duration, type and post-ictal sequelae. An MRI of the brain was performed with and without contrast according to a dedicated seizure protocol on Signa explorer GE logic 1.5 Tesla machine including T1W,T2W axial, FLAIR, SWI, DWI/ADC, Coronal T2W and T1 post contrast images. Contrast was omitted only where a recognised contraindication existed; all studies were reported by two consultant radiologist with a minimum of five years of experience, and the imaging-detected aetiologies were documented on the same proforma. Collected data were analysed using SPSS-25. Age and duration of seizure were summarised as mean ± SD and frequencies with percentages. The association of a causative MRI finding with age group and gender was assessed using the Chi-square test, with $p \leq 0.05$.

The prevalence of causative (potentially epileptogenic) MRI findings was calculated and reported as frequencies. Associations between abnormal MRI findings and demographic characteristics, including age group and gender, were evaluated using the Chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 279 adults presenting with new-onset seizures were included in our study with mean age of the participants was 41.0 ± 11.4 years, with the median age of 41 years (IQR 32 to 50). Men accounted for 165 (59.1%) of the cohort and women for 114 (40.9%). The largest age band was 31 to 45 years, comprising 114 (40.9%) patients, followed by 46 to 65 years in 103 (36.9%) and 18 to 30 years in 62 (22.2%). Generalised tonic clonic seizures were the predominant presentation in 185 (66.3%) patients, while focal seizures occurred in 73 (26.2%) and other types in 21 (7.5%). The median seizure duration was 2.5 minutes (IQR 1.6 to 3.5).

Contrast-enhanced imaging was performed in 241 (86.4%) patients, and 38 (13.6%) were scanned without contrast owing to a recognised contraindication. In 101 (36.2%) patients a causative or potentially epileptogenic structural abnormalities result was found on MRI, while 178 (63.8%) had a structurally normal MRI.

Among the identifiable etiologies, central nervous system (CNS) infection (tuberculomas, abscess, meningitis and encephalitis) was the commonest cause (27, 9.7%). Cerebrovascular disease were the second most common cause, in 23 (8.2%) patients; followed by post-traumatic gliosis or encephalomalacia in 18 (6.5%) patients and neoplastic space-occupying lesions in 17 (6.1%) patients. Mesial temporal sclerosis was identified in 6 (2.2%) patients, while other abnormalities were observed in 10 (3.6%). The complete distribution of MRI findings is presented in Table 1.

The finding of an abnormality was further investigated across age groups and genders, as presented in Table 2. Causative findings were distributed evenly, occurring in 21 of 62 (33.9%) patients aged 18 to 30 years, 42 of 114 (36.8%) aged 31 to 45 years, and 38 of 103 (36.9%) aged 46 to 65 years. The proportion was 61 of 165 (37.0%) among men and 40 of 114 (35.1%) among women. There was no statistically significant difference between age groups and gender regarding abnormal MRIs.

Table 1: Baseline Demographic, Clinical Characteristics, and MRI Findings of the Study Population (n=279)

Baseline Characteristics	Mean ± SD	
Age (years)	41.0 ± 11.4	
Seizure Duration (mins)	**Median (IQR)**	
	2.5 (1.6–3.5)	
Age group, n (%)		
18-30 years	62	22.2
31-45 years	114	40.9
46-65 years	103	36.9
Gender, n (%)		
Male	165	59.1
Female	114	40.9
Seizure type, n (%)		
Generalised tonic-clonic	185	66.3
Focal	73	26.2
Other	21	7.5
MRI-Detected Aetiology, n (%)		
Normal / no causative lesion	178	63.8
Infarct / CVA	23	8.2
Neoplastic / SOL	17	6.1
CNS infection (meningitis/tuberculoma/abscess/encephalitis)	27	9.7
Post-traumatic gliosis / encephalomalacia	18	6.5
Mesial temporal sclerosis	6	2.2
Other	10	3.6
MRI Contrast, n (%)	241	86.4
MRI Causative Finding, n (%)	101	36.2

Table II: Association of MRI Causative Findings by Age Group and Gender (n=279)

Characteristics	**MRI Causative Finding**	**P-Value**

		Yes (n=101)	**No** (n=178)	
Age Groups	18-30 years	21 (33.9)	41 (66.1)	0.911
	31-45 years	42 (36.8)	72 (63.2)	
	46-65 years	38 (36.9)	65 (63.1)	
Gender	Male	61 (37.0)	104 (63.0)	0.748
	Female	40 (35.1)	74 (64.9)	

DISCUSSION

Acute medical assessment of new-onset seizures in adults is common in clinical practice and is a frequent presents a diagnostic challenge in routine clinical practice.[2,5] In adults, seizures are more likely to be associated with an identifiable structural or systemic cause; therefore, early and accurate determination of the underlying etiology is essential for appropriate therapeutic management.[6] Cross-sectional imaging, particularly MRI, can provide greater sensitivity than traditional clinical evaluation for the identification of the underlying cause.[10,13] Neuroimaging particularly MRI can detect structural abnormalities that may not be apparent on clinical assessment alone, thereby improving diagnostic accuracy and guided subsequent management.

The aim of the present study was to identify the prevalence of causative findings and the range of aetiologies that could be diagnosed on MRI in adults having their new onset seizure.

The mean age of participants in the present cohort was 41.0 ± 11.4 years, with a slight male predominance (59.1% men vs 40.9% women). This demographic pattern is consistent with the large first-seizure cohort of Hakami et al.[15], in which the mean age was 42.2 years and 61% of patients were men. A comparable pattern was reported by Mahmoud et al.[16] from Egypt, who found a 63% male predominance among 120 adults with new-onset seizures. In contrast, Ali et al.[17] observed a female preponderance (55.1%) in adults presenting to an emergency department in Karachi, illustrating that gender distribution may vary with the recruitment setting and the referral pathway.

Generalised tonic-clonic seizures were the predominant presentation in 185 (66.3%) patients, while focal seizures occurred in 73 (26.2%) and other types in 21 (7.5%). This is in keeping with studies in which generalised tonic-clonic seizures were the most common type in adults with new-onset seizures. Ali et al.[17] reported a very similar proportion of generalised tonic-clonic events (74.2%) as the leading semiology, and Hosalli et al.[18] documented a comparable predominance of generalised tonic-clonic seizures in an adult tertiary care cohort in Mysore.

A causative MRI finding was present in 101 (36.2%) patients, while 178 (63.8%) had a structurally normal study. Hakami et al.[15] reported potentially epileptogenic lesions on MRI in 23% of adults presenting to a first-seizure clinic, and Ali et al.[17] identified a structural lesion of the brain as the leading category of confirmed aetiology in adults presenting to the emergency department, underscoring the central diagnostic role of MRI after a first seizure.

CNS infection (tuberculomas, abscess, meningitis, and encephalitis) was the most common causative finding in our cohort, accounting for 27 (9.7%) patients. Similarly, Song et al. reported that 20.6% of adults with tuberculous meningitis developed new-onset seizures during long-term follow-up, highlighting CNS tuberculosis as an important cause of seizure disorders.[19] The detection of an infective focus on MRI has direct therapeutic implications, as it redirects care toward targeted antimicrobial or antiparasitic treatment rather than antiseizure medication alone.[10]

Infarct or cerebrovascular accident was the second most common aetiology in our study, seen in 23 (8.2%) patients, consistent with the recognised role of cerebrovascular disease as a leading structural cause of seizures in adult life. Galovic et al.[20] describe post-stroke seizures as a major contributor to adult-onset epilepsy, particularly in middle-aged and older patients, and Mahmoud et al.[16] identified cerebrovascular disease as the most common aetiology in an Egyptian cohort of new-onset seizures (44.17%), and the highest prevalence was in the older adults (>65 years) age group (65.28%).

Post-traumatic gliosis or encephalomalacia accounted for 18 (6.5%) of causative findings. Such residual structural lesions from prior head injury are well recognised epileptogenic foci. Moran et al.[21] reported an overall post-traumatic seizure incidence of 4.95% in a large national database of traumatic brain injury admissions, with subdural haematoma independently elevating seizure risk, supporting the biological plausibility of trauma-related gliosis as a substrate for later seizure activity.

Neoplastic space-occupying lesions were identified in 17 (6.1%) patients. Brain tumours are a well-established source of both focal and generalised seizure activity, arising from cortical irritation and disruption of local neuronal networks.[22] Hakami et al.[15] similarly reported tumours in 15% of adults with focal-onset seizures and epileptogenic MRI lesions, highlighting that neoplastic aetiology, although not the most frequent, remains an important consideration in first-seizure evaluation.

Mesial temporal sclerosis was observed in 6 (2.2%) patients. Although uncommon in an unselected new-onset seizure population, this finding is highly relevant when present, as it is strongly associated with focal epilepsy and often with pharmacoresistance. Hakami et al.[15] reported mesial temporal sclerosis in 9% of adults with focal seizures and epileptogenic MRI lesions, consistent with our observation that such changes are seen predominantly in a small but clinically important subset of patients.

There was no statistically significant association between age group or gender and the presence of a causative MRI finding. Causative findings were distributed evenly across age bands (33.9% at 18–30 years, 36.8% at 31–45 years and 36.9% at 46–65 years) and were similar in men (37.0%) and women (35.1%). This even distribution suggests that neither age nor gender alone is a reliable predictor of a structural lesion in a population referred for first-seizure imaging, and reinforces the argument for liberal use of MRI across the adult age range rather than restricting imaging to older patients.[13,23]

Our study had few limitations. This study was conducted at a single radiology centre serving hospital-based referral population, which may limit the generalisability of observed etiological proportions. The cross-sectional design restricts assessment to imaging findings at presentation and did not permit evaluation of their relationship with seizure recurrence or long-term clinical outcome. In addition, acute symptomatic and metabolic causes without a structural imaging correlate would not be captured by an imaging-based classification, and should be considered when interpreting these findings. These estimates would be improved with larger, multicentre cohorts and standardised imaging protocols for first seizures which would provide more robust and generalized estimates.

Overall, the results indicate a pivotal role for MRI in the evaluation of adult onset seizures and justify the recognition of the fact that

many of them have a treatable underlying cause identifiable by MRI. The high prevalence of CNS infection underscore the importance of region specific data. Comparable distribution of imaging findings across age and sex groups suggest neuroimaging should be considered liberally in adults with new onset seizures.

CONCLUSION

A treatable structural abnormality was detected on MRI in a substantial minority of adults with new- onset seizures, with infective and vascular lesions were predominating. The absence of meaningful variation in findings across age and gender groups support a low threshold for MRI in all adults with a first seizures, irrespective of demographic characteristics.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the relevant Institutional Review Board/Ethics Committee of Dow University of Health Sciences (DUHS), Karachi, Pakistan.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization: Qurat Ul Ain M. Saleem, Nasreen Naz
Methodology: Qurat Ul Ain M. Saleem, Nasreen Naz Qurat Ul Ain Hadi
Data Collection: Qurat ul Ain M. Saleem
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Writing – Original Draft: Qurat Ul Ain M. Saleem
Writing – Review & Editing: All authors
All authors read and approved the final version of the manuscript.

Informed Consent

Written informed consent was obtained from all participants before enrollment in the study.

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Conflict of Interest

The authors declare that they have no competing interests.

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Declaration of AI-Assisted Language Editing

No AI used.

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