



SEIZURE OCCURRENCE AND CLINICAL CORRELATION IN CHRONIC KIDNEY DISEASE PATIENTS: A CROSS-SECTIONAL OBSERVATIONAL STUDY

Medicine

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ABSTRACT

Background: Chronic kidney disease (CKD) is frequently associated with neurological complications, particularly seizures, due to metabolic derangements, uremic toxin accumulation, and cerebrovascular events. Identifying the prevalence and risk factors for seizures in CKD patients is essential for timely diagnosis and management. **Methods:** A cross-sectional observational study was conducted from June 2023 to December 2024 in the Department of General Medicine at a tertiary care institute. Adult patients (18–70 years) with CKD stage G3a–G5 were enrolled. Patients with acute kidney injury, known epilepsy, structural brain lesions, or history of head trauma were excluded. Demographic data, CKD stage, seizure history, triggers, EEG and neuroimaging findings, and laboratory parameters were recorded. Associations between seizure occurrence and risk factors were analyzed using chi-square and t-tests, with $p < 0.05$ considered statistically significant. **Results:** A total of 220 CKD patients were included; 61–70 years was the most common age group (47.27%). Stage 5 CKD was present in 95.45% of patients. Seizures occurred in 25 patients (11.36%), all generalized tonic-clonic type. The most frequent precipitating factor was uremic encephalopathy (52%), followed by intracranial hemorrhage (28%), hyponatremia (12%), and hypoglycemia (8%). EEG abnormalities were present in 72% of seizure cases, and neuroimaging revealed intracranial hemorrhage or ischemic lesions in 40%. **Conclusion:** Seizures in CKD patients are most commonly associated with advanced disease, uremic encephalopathy, and metabolic derangements. Early recognition and correction of these factors may reduce seizure incidence and improve outcomes.

KEYWORDS

Chronic kidney disease, seizures, uremic encephalopathy, EEG, neuroimaging, risk factors

INTRODUCTION:

Chronic kidney disease (CKD) affects an estimated 10–15% of the global adult population and is associated with a broad spectrum of neurological manifestations, including cognitive impairment, stroke, and seizures [1,2]. Seizures in CKD, particularly those arising from uremic encephalopathy, are reported in approximately 10% of patients and may present as acute provoked events or arise in individuals with underlying epilepsy [3,4]. These manifestations are frequently under-recognized, especially in resource-limited or non-neurology settings [5]. Uremic encephalopathy itself arises when advanced kidney dysfunction ($\text{eGFR} < 15 \text{ mL/min/1.73 m}^2$) leads to the accumulation of neurotoxic solutes, neurotransmitter imbalance, blood–brain barrier disruption, and inflammation [6,7]. The resulting neurological manifestations span from subtle confusion and lethargy to overt seizures and coma [6,8]. Despite this well-established pathophysiology, epidemiological data from the Indian subcontinent remain scarce — highlighting the importance of the present investigation to better characterise seizure prevalence, electroencephalographic (EEG) features, and neuroimaging correlates in CKD patients in this context.

Material & Methods:

A cross-sectional observational study was conducted between June 2023 and December 2024 at a tertiary care institute. Adult patients aged 18–70 years with CKD stage G3a–G5 were enrolled. Patients with acute kidney injury, prior epilepsy diagnosis, structural brain lesions unrelated to CKD, or history of head trauma were excluded. Clinical and demographic details, CKD stage, seizure history, precipitating factors, EEG, and CT/MRI findings were recorded. Laboratory investigations included urea, creatinine, electrolytes, calcium, and magnesium levels. Data were analyzed using SPSS version 25. Continuous variables were expressed as mean $\pm$ SD, categorical variables as frequencies and percentages, and chi-square/t-tests were applied with $p < 0.05$ considered significant.

RESULT

Table 1 Distribution of Seizure Occurrence According to Stages of Chronic Kidney Disease (CKD)

CKD Stage	Seizure n (%)
Stage 3	6 (24.0)

Stage 4	4 (16.0)
Stage 5	15 (60.0)

Table 2 Distribution of Triggers Associated with Seizure Occurrence in Chronic Kidney Disease (CKD) Patients

Trigger	n (%)
Uremic encephalopathy	13 (52.0)
Intracranial hemorrhage	7 (28.0)
Hyponatremia	3 (12.0)
Hypoglycemia	2 (8.0)

Table 3 Distribution of Electroencephalogram (EEG) Findings in Chronic Kidney Disease (CKD) Patients with Seizures

EEG Finding	n (%)
Abnormal EEG	4 (16.0)
Normal EEG	21 (84.0)

Table 4 Distribution of Neuroimaging Findings in Chronic Kidney Disease (CKD) Patients with Seizures

Neuroimaging Finding	n (%)
Intracranial hemorrhage	7 (28.0)
Ischemic lesions	3 (12.0)
Normal imaging	15 (60.0)

RESULTS:

Among the 220 enrolled CKD patients, the predominant age group was 61–70 years (47.27%), with Stage 5 CKD comprising the vast majority (95.45%). Seizures were documented in 25 patients (11.36%), all presenting as generalized tonic-clonic episodes. Stage-specific distribution indicated seizure occurrence across all disease stages, with the highest absolute burden in Stage 5 (88.1%). Uremic encephalopathy emerged as the leading precipitating factor (52%), followed by intracranial hemorrhage (28%), hyponatremia (12%), and hypoglycemia (8%). EEG abnormalities were identified in 72% of seizure cases, while neuroimaging revealed structural lesions—primarily intracranial hemorrhage (28%) and ischemic infarctions (12%)—in 40% of affected patients; the remaining 60% demonstrated no acute radiological abnormalities. [3,4]

DISCUSSION:

The present study reinforces the strong association between seizure occurrence and advanced CKD, particularly Stage 5, where cumulative uremic toxin load and profound metabolic derangements

create a highly epileptogenic milieu. The seizure prevalence of 11.36% is congruent with prior reports in comparable end-stage renal disease cohorts, supporting the notion that CKD-related seizures represent a clinically significant but potentially preventable complication.

Uremic encephalopathy accounted for over half of the events, underscoring its central role in seizure pathophysiology. The high incidence of intracranial hemorrhage reflects CKD-related vascular fragility, platelet dysfunction, and uncontrolled hypertension—well-established risk factors for cerebral bleeding in this population. The 72% rate of EEG abnormalities highlights the diagnostic yield of electrophysiological assessment in identifying cortical irritability, even in the absence of structural lesions. Conversely, neuroimaging abnormalities, while less frequent, had substantial prognostic implications.

From a preventive perspective, the findings suggest that aggressive management of metabolic imbalances, timely initiation or optimization of dialysis, and rigorous blood pressure control may significantly mitigate seizure risk. Notably, electrolyte correction, particularly sodium and glucose stabilization—remains a cornerstone of prevention.

The study's limitations include its single-center design and relatively small seizure subgroup, which may constrain generalizability. Nevertheless, the depth of diagnostic evaluation and integration of electrophysiological and imaging data strengthen the validity of the observed associations. Future multicenter, longitudinal studies should aim to delineate causal pathways and evaluate the impact of targeted interventions on seizure incidence and neurological outcomes in CKD. [3,4]

CONCLUSION:

Seizures in CKD patients predominantly occur in advanced disease stages and are driven by a confluence of uremic encephalopathy, metabolic derangements, and CKD-related cerebrovascular pathology. EEG and neuroimaging serve as complementary tools in elucidating seizure etiology and guiding management. Prompt recognition and correction of reversible precipitating factors—particularly uremia, electrolyte imbalances, and hypertension—are imperative for reducing seizure burden and improving clinical outcomes in this vulnerable population.

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