Journal of Medical and Health Studies
ISSN: 2710-1452
DOI: 10.32996/jmhs
Journal Homepage: www.al-kindipublisher.com/index.php/jmhs

JMHS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

When Cancer Mimics Epilepsy: Focal Seizures Caused by Hypermagnesemia, Hyperphosphatemia, and Hypercalcemia from Breast Malignancy

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| ABSTRACT

Neurological presentations of malignancies are quite rare, especially for tumors outside of the central nervous system. Usually, these presentations are secondary to metastasis to the brain or underlying metabolic derangement. This case presents a 62-year-old female who presented to the emergency department with drowsiness and later focal seizures. After laboratory and radiological investigations, she was diagnosed with stage four breast cancer with bone metastasis, causing electrolyte disturbances, leading to her presentation. This case highlights the importance of considering metabolic etiologies when evaluating focal seizures, especially in patients with malignancy. These abnormalities are more common in this population, particularly in patients with bone metastasis. Prompt identification and diagnosis of such reversible causes can alter the clinical management and improve patient outcomes.

| KEYWORDS

"Hypercalcemia", "Hypermagnesemia", "Hyperphosphatemia", "Seizures", "Osteolytic Lesions", "Malignancy"

| ARTICLE INFORMATION

ACCEPTED: 20 July 2025 **PUBLISHED:** 30 August 2025 **DOI:** 10.32996/jmhs.2025.6.3.27

1. Introduction

Breast cancer is one of the most common malignancies in women and typically presents with identifiable signs such as palpable breast masses or nipple abnormalities, enabling early detection. However, in advanced stages, particularly among older patients, the presentation may be atypical, leading to diagnostic delays and worse prognoses. In advanced malignancies, metastasis to the brain can manifest dramatically with neurological symptoms such as headaches, altered mental status, or seizures. In this case, a 62-year-old hypertensive woman presented with altered mental status and focal seizures. Ultimately, she was found to have osteolytic bone metastases, which led to significant electrolyte disturbances - most notably hypercalcemia - and this metabolic derangement most plausibly explains her clinical presentation. This case highlights a rare and critical presentation of advanced breast cancer, underscoring the importance of early neurologic assessment in oncologic emergencies.

2. Case report:

A 62-year-old female patient of South Asian origins presented to the emergency department with a history of drowsiness and unresponsiveness for 7 hours before arrival. The patient was a known case of hypertension, with no other significant past medical history. She was also noted to have abnormal jerky movements of the right upper and lower limbs. The patient was given valium, and the movements were aborted. The patient has been complaining of right lower leg pain for the past few days and was on NSAIDs and supplements (containing magnesium, zinc, calcium, and phosphates) for the past two days. The patient's family reported no history of trauma, vomiting, loss of consciousness, smoking, alcohol, or recreational drugs before the onset of symptoms. Her condition later continued to deteriorate, and she has been having more frequent right-sided seizures. Later, she developed hypoxia and started gurgling. Rapid sequence intubation was started, and the patient was intubated promptly to protect the airway. Vitals on presentation were as follows:

- Heart rate of 97 beats per minute.
- Blood pressure of 179\101 mmHg.
- Oxygen Saturation of 98% (on ACVC mode, connected to a ventilator).
- The temperature is 37 degrees Celsius.

On physical examination patient was drowsy before intubation. Both the right upper and lower limbs were involuntarily moving. The patient was unresponsive to painful stimuli with a Glasgow Coma Scale (GCS) of 5/15 prior to intubation. The rest of the examination was unremarkable.

Imaging for this patient included a Chest x-ray, which was unremarkable, and a CT brain was obtained, showing scattered subcortical white matter areas of low attenuation, which might be a part of micro-angiopathic ischemic changes. No acute intra- or extra-axial hemorrhage nor mass effect or mid-line shift can be seen. Numerous areas of lucent lesions all over the calvaria, including the base of the skull, as well as the right condyle of the mandible. These lesions need more evaluation as bone metastases are suspected. Initial laboratory investigation can be noted in Table 1, indicating high levels of magnesium, phosphate, and calcium. Upon admission, tumor markers were sent, which can be noted in Table 2. As CA 15-3 was elevated, the breast was examined, where a lump was palpated. The histopathology showed invasive ductal carcinoma, and the patient was sent for a full workup to stage the malignancy. After a full workup, the patient was labeled as stage four breast carcinoma with extensive metastasis to the bone and was thus sent for palliative care. Patient is still intubated and in the hospital, as per the writing of this article.

Table 1: Serum Laboratory Investigation on Presentation.

Investigation	Value	Interpretation
White blood cell (WBC)	13.74 (3.4 - 9.6)	Normal
Hemoglobin (Hb)	13.80 (11.6 - 15)	Normal
Platelets	270 (150 - 400)	Normal
Sodium	140 (136 -145)	Normal
Calcium	4.78 (2.2 - 2.55)	High
Potassium	4.3 (3.5 - 5.1)	Normal
Magnesium	1.30 (0.66 - 1.07)	High
Inorganic phosphate	2.2 (0.75 - 1.65)	High
Parathyroid hormone	1.73 (1.96 - 9.33)	Low
Glucose (random)	7.9 (3.9 - 7.8)	High
Urea	14.1 (3.2 - 8.2)	High
Creatinine	214 (45 - 90)	High

Table 2: Tumor Markers Level.

Investigation	Value	Interpretation
Alpha fetoprotein	3.2 (0 - 8)	Normal
CA 125	37.6 (<= 35)	High
CA 15-3	1785.6 (<= 31.3) !!	High
CA 19-9	12.9 (<= 37)	Normal

3. Discussion:

The commonest presentation of breast cancer is a self-detected, exam-detected, or imaging-detected breast lump (1). However, in the older population, they are more likely to present with advanced disease, often due to diagnostic delays and inadequate staging (1-2). These late presentations are linked to decreasing awareness of cancer symptoms, particularly those beyond the classic "lump," and lower screening rates among the oldest age group (1-2). Studies show that older adults take longer to recognize symptoms, even though they may seek care promptly once symptoms are noticed and may underappreciate their cancer risk (3). This combination of reduced symptom awareness and screening leads to later detection and poorer outcomes in elderly women (4). Patients with late-stage malignancies (all types, yet particularly the central nervous system) could present with several neurological symptoms (see **Table 3**). A spectrum of neurological disease forms and patients with advanced malignancies seen in the Department of Neurology at the Memorial Sloan-Kettering Cancer Center, from Jul 1, 1990, to December 31, 1990 (5).

A presentation of Altered mental status is the second most common amongst the neurological symptoms (5). However, in the case of breast cancer, a presentation of a non-breast lump is very rare (6). This leads to a diagnostic delay, often linked to atypical symptom presentations, such as nipple changes, breast pain, or non-breast-related signs like back pain or unexplained weight loss, rather than the more typical breast lump (6).

Table 3: Advanced Malignancies Seen in the Department of Neurology at the Memorial Sloan-Kettering Cancer Center, from Jul 1, 1990, to December 31, 1990 (5).

Symptom/ neurological diagnosis	Percentage
Back pain	18.2%
Altered mental status	17.1%
Headache	15.4%
Brain metastasis	15.9%
Metabolic encephalopathy	10.2%
Pain due to bone metastasis	9.9%
Epidural extension	8.4%

Such atypical presentations include seizures, which are frequently observed in patients who do not have a history of epilepsy. These seizures are typically caused by factors that can sometimes be reversible. A detailed evaluation is necessary to exclude primary neurological disorders and determine the exact cause of the seizures (7). A seizure presentation in the emergency department is not a rare encounter; early recognition of the cause is essential to optimize patient treatment. A CT scan of the brain can rule out any structural cause of the seizure, while electrolyte serum levels will show any metabolic cause. Seizures may manifest in various forms, including convulsive or non-convulsive episodes, and they can be focal, generalized, or initially focal before progressing to generalized. Not all seizures involve tonic-clonic convulsions, and electrical seizure activity can occur without any obvious motor signs, particularly in critically ill patients who are receiving muscle relaxants (7). It is important to highlight that in seizures occurring secondary to electrolyte disturbance, the treatment of the underlying abnormality is likely required to control the episodes. Therefore, the primary goal of treatment is to address the underlying cause while managing seizures with appropriate short-term anticonvulsant medications (7).

Toxins and metabolic conditions trigger seizures by disturbing the balance necessary for normal brain function or by causing insults to the cerebral cortex. When seizures are caused by extracranial factors, they are referred to as reactive seizures (8). Toxins, for example, can induce seizures by disrupting the balance between excitation and inhibition in the nervous system or by interfering with energy metabolism. Many therapeutic drugs, as well as illicit substances, can cause seizures through similar mechanisms (7-8). Metabolic disorders may lead to seizures by altering energy metabolism, affecting osmolality, or producing endogenous toxins. In some cases, these conditions can also impact the way antiepileptic drugs or seizure-triggering

medications are processed by the body, potentially increasing seizure risk (7-8). Although seizures are a serious sign of underlying conditions, reactive seizures often have the potential to be reversed if the cause is identified and treated. Proper diagnosis and management of the underlying metabolic or toxic disturbances are essential, as addressing these factors may prevent future seizures (8).

Hypercalcemia is more frequently encountered in clinical practice than hypocalcemia. However, it rarely leads to seizures. Its clinical symptoms are largely influenced by the cause, how abruptly the calcium level rises, and the patient's overall health. Most notably, severe hypercalcemia primarily affects the nervous system and gastrointestinal tract. A sudden elevation to moderate levels (12–13.9 mg/dL) often triggers significant neurological effects, whereas individuals with long-standing severe hypercalcemia (≥14 mg/dL) may exhibit only mild neurological signs. The most common nervous system symptoms include altered mental states such as lethargy, confusion, and coma (9). Elevated calcium levels decrease neuronal membrane excitability, which accounts for the rarity of seizures. However, seizures may still occur under circumstances like hypercalcemia-induced hypertensive encephalopathy or cerebral vasoconstriction (9).

Hypermagnesemia, on the other hand, is extremely rare (9-10). An elevation in serum magnesium is usually due to medication side effects. Such in the case presented, where the patient was advised to take supplements, which worsened the electrolyte imbalance even further. Magnesium has an inhibitory effect on N-methyl-D-aspartate (NMDA) glutamate receptors and increases the production of vasodilator prostaglandins, all of which result in stabilization of neuronal membranes, decreasing the likelihood of seizures (9). However, hypermagnesemia can cause seizures indirectly by suppressing the production of parathyroid hormones, leading to hypocalcemia, consequently leading to the development of seizures (9, 11-12). Hyperphosphatemia has a similar effect as hypermagnesemia, where the main reason for developing seizures is due to a secondary drop in calcium (13).

Early recognition and targeted correction of electrolyte abnormalities in the emergency department (ED) are critical for preventing life-threatening complications. Electrolyte disturbances, such as hyperkalemia, hyponatremia, and hypokalemia, can lead to severe outcomes, including cardiac arrhythmias, seizures, and altered mental status. Prompt identification through laboratory tests and clinical assessment allows for timely.

Intervention (10, 14). In the ED, clinicians should maintain a high index of suspicion for electrolyte imbalances in patients presenting with nonspecific symptoms like confusion, weakness, or arrhythmias. Early intervention and monitoring are essential to mitigate risks and improve patient outcomes (10-14).

4. Conclusion

Although younger breast cancer patients often exhibit classic, easily recognizable signs such as palpable lumps or nipple changes, which facilitate early detection and diagnosis, older patients with more advanced disease may present with vague or non-specific symptoms, as seen in this case. A presentation of altered mental status plus seizures in the emergency setting must have a priority in ruling out cerebrovascular events. Once that's excluded, a swift and thorough evaluation of electrolyte levels is essential to identify and correct any reversible imbalances promptly, which can significantly impact patient outcomes.

Funding: This research received no external funding
Conflicts of interest: The authors declare no conflict of interest
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers

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