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Focal Epilepsy with subcortical grey matter heterotopia

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Abstract

A 38-year-old man with recurrent bilateral tonic–clonic seizures since 2018 presented in January 2025 for further evaluation. His seizures occurred 1–2 times per month and were commonly precipitated by sleep deprivation or exposure to cold water. Episodes were accompanied by tongue biting, post-ictal confusion, and amnesia. He had no significant medical or family history, and neurological examination was unremarkable. MRI of the brain demonstrated nodular subcortical grey-matter heterotopia adjacent to the right putamen and a similar lesion in the left corona radiata. The EEG recorded during wakefulness was normal. Laboratory tests were notable only for elevated total cholesterol. Findings were consistent with focal epilepsy secondary to subcortical grey-matter heterotopia.

Keywords: *seizures, grey-matter heterotopia, insular cortex, focal epilepsy*

Introduction

Grey-matter heterotopia represents a disorder of neuronal migration in which clusters of cortical neurons remain trapped in abnormal locations within the brain. These malformations arise during embryogenesis and may present clinically with epilepsy, cognitive impairment, or focal neurological symptoms. Subcortical grey-matter heterotopia is less common than periventricular heterotopia but is well recognized as a potential epileptogenic substrate. Depending on anatomical location, patients may experience focal or generalized seizures triggered by various environmental or physiological factors. This report describes a

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patient with recurrent tonic–clonic seizures associated with bilateral subcortical nodular heterotopia.

Case presentation

A 38-year-old male attended the Neurology Department of No. (2) Military Hospital (500-bedded) in January 2025 with a history of recurrent seizures beginning in 2018. The events occurred one to two times monthly and were characterized by generalized tonic–clonic movements with loss of awareness. He frequently experienced lateral tongue biting and had a period of confusion and amnesia following each episode. The seizures were predictably triggered by sleep deprivation and exposure to cold water during bathing or washing.

The patient denied headaches, focal weakness, sensory changes, or visual disturbances. He had no prior medical illnesses, no previous central nervous system infections or head trauma, and no perinatal complications or developmental delay. There was no family history of epilepsy or neurological disease. He did not consume alcohol or recreational drugs.

Neurological examination showed normal cognition, intact cranial nerves, full strength, preserved sensation, and normal coordination. Systemic examination was also unremarkable. Routine laboratory tests were within normal limits except for elevated serum cholesterol.

An interictal EEG demonstrated a normal background rhythm without epileptiform discharges (Figure 1). Brain MRI revealed a well-defined, T1- and T2-isointense nodular lesion within the subcortical white matter posterior to the right putamen, positioned between the posterior insular cortex and the right lateral ventricle. The lesion measured 0.9 × 1.2 cm and exhibited signal characteristics identical to cortical grey matter on all sequences, consistent with subcortical nodular grey-matter heterotopia. A second smaller heterotopic nodule measuring 0.9 × 0.5 cm was observed in the left corona radiata (Figures 2–4).

Case discussion

Discussion

Grey-matter heterotopia results from incomplete neuronal migration during fetal development. Depending on the extent and location of the heterotopic tissue, patients may be asymptomatic or present with drug-resistant focal epilepsy. Subcortical heterotopia—such as that seen in this case—is less common than periventricular forms but is well recognized as a source of abnormal cortical excitability.

Heterotopic grey matter contains functionally active neurons capable of generating epileptiform discharges and participating in seizure propagation networks. The bilateral tonic–clonic seizures observed in this patient are likely secondary to focal onset with rapid generalization from the heterotopic nodules.

The patient identified sleep deprivation and exposure to cold water as consistent seizure triggers. Temperature- or water-related reflex epilepsies, although rare, are documented in the literature. Because the right heterotopic lesion lies adjacent to the insular cortex—a region involved in autonomic regulation, interoception, and thermal sensation—its involvement may explain the patient's sensitivity to environmental triggers.

Despite normal EEG findings, epilepsy associated with heterotopia can still be present, as interictal EEGs may be normal in many patients. MRI therefore plays a crucial role in identifying subtle structural abnormalities responsible for seizure onset.

DISCLOSURE

Financial support: None

Conflict of interest: None

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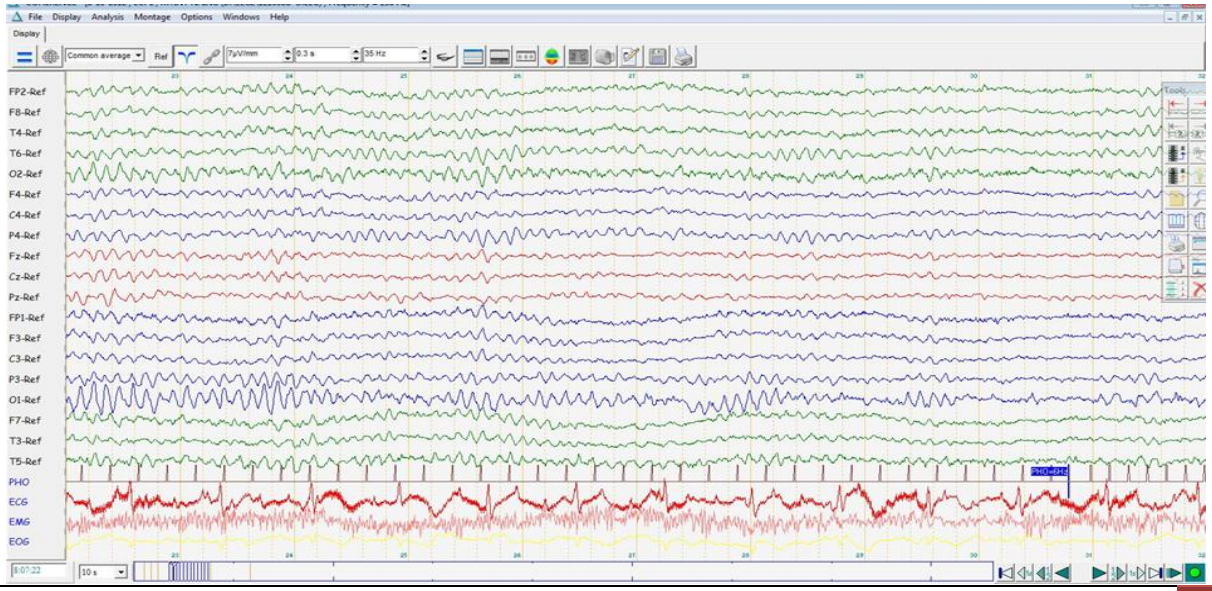

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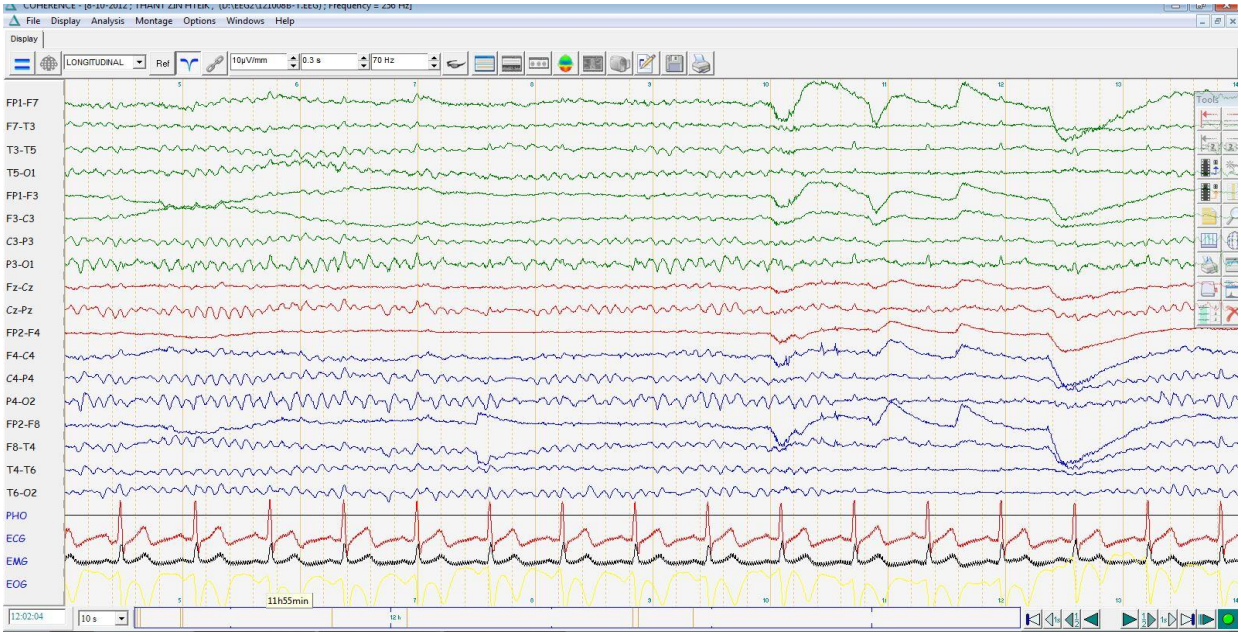
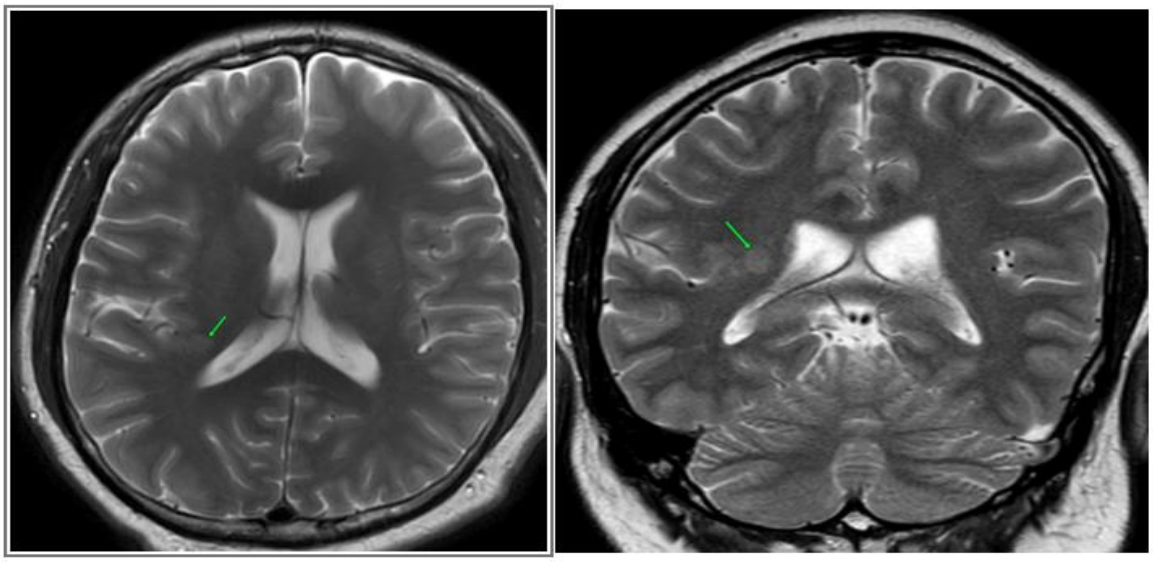
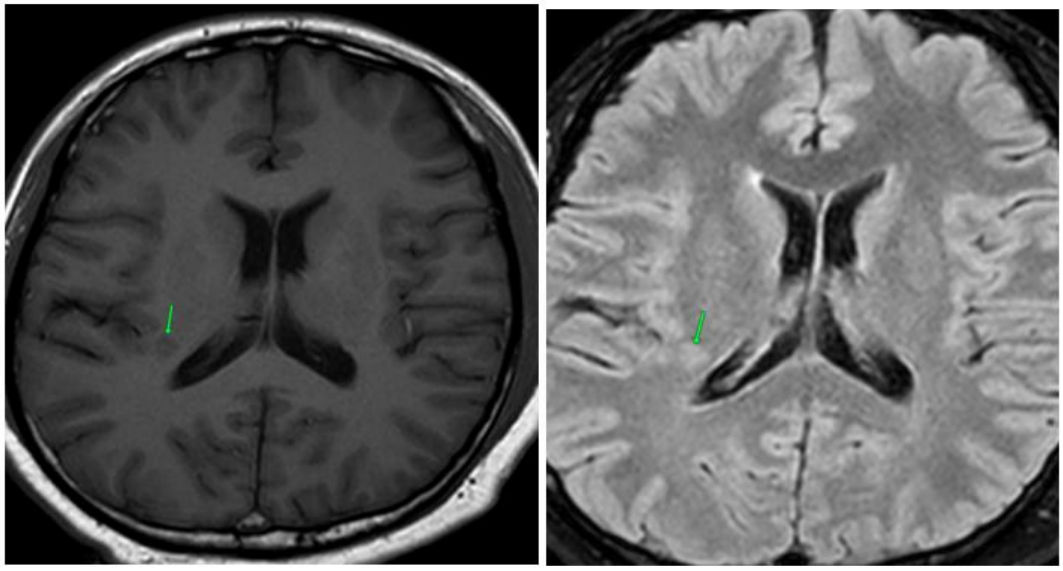


Figure(1): Normal awake EEG



Figure(2): nodular subcortical grey matter heterotopia



Figure(3):nodular subcortical grey matter heterotopia

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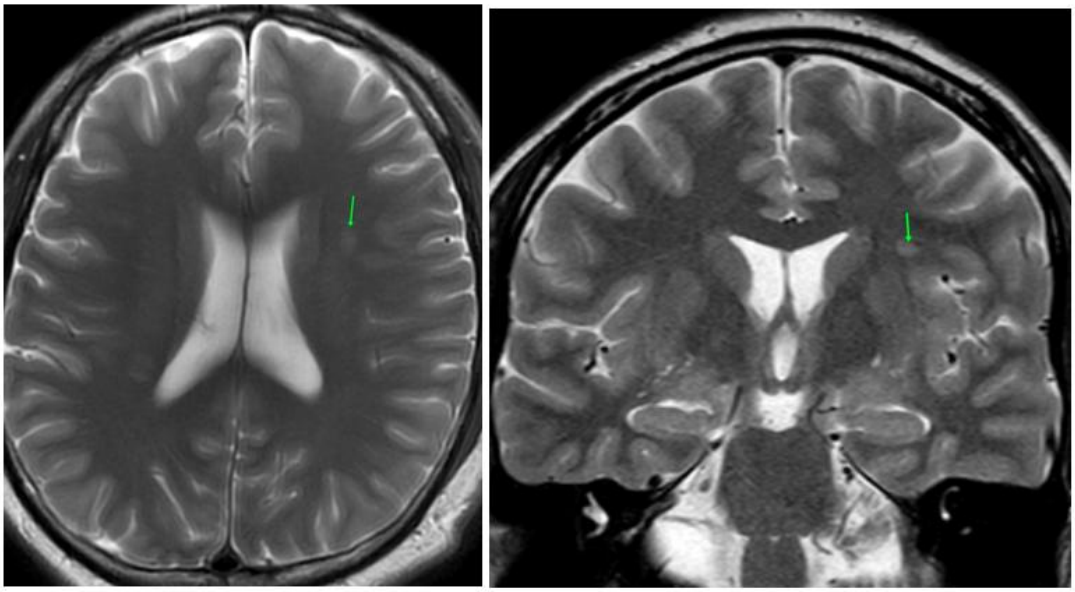

Figure(4): nodular subcortical grey matter heterotopia

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