Frontal lobe epilepsy manifesting as vertigo: a case report and literature review

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Abstract
Frontal lobe epilepsy is a common neurological disorder with a broad spectrum of symptoms. Frontal lobe epilepsy presenting with vertigo is extremely rare, and the relevant pathogenesis remains unclear. Herein, we report a case of frontal lobe epilepsy manifesting as vertigo, and we review the relevant literature. A 34-year-old woman presented with a 10-year history of general tonic–clonic seizures. In the month prior to admission, she experienced nocturnal seizures on two occasions. Video electroencephalogram monitoring showed frequent clinical seizures during which the patient felt transient vertigo. The ictal electroencephalogram revealed a medium-amplitude spike and slow wave complex originating from the frontal lobes. The patient was treated with oral sodium valproate, levetiracetam, and lamotrigine. After a 6-month follow-up period, her seizures were well controlled. Our findings expand the symptom spectrum of epilepsy, suggesting that vertigo can be an uncommon clinical manifestation of frontal lobe epilepsy. Although the pathological correlation between vertigo and epilepsy remains elusive, our findings indicate that vestibular cortical neurons may participate in periodic epileptiform discharges of the frontal lobe. Clinicians should be aware of a potential diagnosis of epilepsy in patients presenting with vertigo as the onset symptom because this condition is usually underdiagnosed.

Keywords
Frontal lobe epilepsy, vertigo, vestibular cortex, case report, electroencephalogram, tonic–clonic seizures

Introduction
Frontal lobe epilepsy is a neurological disorder that is characterized by brief, recurring, partial seizures originating from the frontal lobe. It is the second most
common type of epilepsy, following tempo-
ral lobe epilepsy.1 The clinical manifesta-
tions of frontal lobe epilepsy differ
considerably depending on the region of
the frontal cortex that is affected. Clinical
manifestations include abnormal tonic pos-
ture, repetitive vocal outbursts, and dyston-
ic motor movements.2 However, frontal
lobe epilepsy manifesting as vertigo is
extremely rare.3 Furthermore, the patho-
genesis of vertigo in frontal lobe epilepsy
remains unclear.

Herein, we report a case of frontal lobe
epilepsy manifesting as vertigo, and review
the relevant literature. Our findings expand
the symptom spectrum of epilepsy and
provide suggestive evidence for the patho-
logical correlation between vertigo and
epilepsy.

Case report

This case was reported according to the
ethical guidelines of the Declaration of
Helsinki and was approved by the Human
Ethics Committee of Peking Union Medical
College Hospital, China. Written informed
consent was obtained from the patient for
the publication of this report.

A 34-year-old woman presented with a
10-year history of general tonic–clonic seiz-
ures. The seizures lasted for 2 to 3 minutes
each, with consciousness disturbance and
no significant aura. Interictal electroen-
cephalogram results were normal, and
brain magnetic resonance imaging results
revealed no abnormalities. The patient’s
medical history was unremarkable. The
patient was diagnosed with epilepsy, and
oral sodium valproate was prescribed.
During the administration of sodium val-
proate, her seizures were partially relieved;
only transient unconsciousness and right-
arm myoclonic movements persisted, at a
frequency of approximately once per week
(each attack lasting for several seconds).
Seven years before presentation, the patient
gradually reduced her dosage of sodium
valproate. She stopped taking sodium val-
proate 4 years before presentation. One
month prior to admission, she woke up sud-
denly during nocturnal sleep with palpita-
tions, limb stiffness, and jerking movements.
The attack lasted for approximately
10 minutes, during which she was uncon-
scious. Two weeks before admission, the seiz-
ures reoccurred. During hospitalization,
video electroencephalogram monitoring
revealed frequent clinical seizures during
which the patient felt transient vertigo
(Supplemental videos 1 and 2). No nystagmus
was observed. Ictal electroencephalogram
results revealed a medium-amplitude spike-
and slow-wave complex (4–5 Hz) originating
from the frontal lobes (predominantly on the
left side; Figure 1), which supported a diag-
nosis of frontal lobe epilepsy.4,5 Oral sodium
valproate (0.5 g twice per day), levetiracetam
(0.5 g twice per day), and lamotrigine (50 mg
twice per day) were administered. At a 6-
month follow-up, the frequency of seizures
was markedly reduced (Figure 2).

Discussion

Vertigo and epilepsy are both common
symptoms that are presented to general
practitioners. Differential diagnosis is cru-
cial for clinical treatment and determines
patient prognosis. Thus, multidisciplinary
collaboration should be encouraged.

Vertigo is a common neurological symp-
tom with a life-time prevalence of 20% to
30% in the general population. However,
epilepsy is an uncommon factor in central
vertigo, and is difficult to diagnose.
Although the concepts of vertigo and epi-
lepsy have been investigated for centuries,
the definitive association between these con-
ditions remains unclear. In the nineteenth
century, several scholars6 proposed the
term ‘vertiginous epilepsy’. However, epi-
lepsy-related vertigo is usually over-
looked because of the low incidence of
Figure 1. Ictal electroencephalogram of the patient showing a medium-amplitude spike- and slow-wave complex (4–5 Hz) originating from the frontal lobes (predominantly on the left side).

Figure 2. Follow-up electroencephalogram of the patient showing no abnormalities.
vertigo in epileptic patients. According to recent literature, epilepsy-related vertigo occurs in approximately 8.4% of all epileptic diseases, and the incidence is slightly higher in pediatric patients compared with the rates observed in adults. The most common epileptogenic foci are located in the temporal lobe (approximately 80% of all cases), followed by the parietal lobe, the occipital lobe, and the frontal lobe. Vertiginous epilepsy is thought to be caused by periodic epileptiform discharges of vestibular cortical neurons.

In recent years, the vestibular cortex has been revealed to have structural and functional connections with the frontal lobe. Neurophysiological studies have reported that the vestibular cortex is located in the junctional zone of the temporal, parietal, and occipital lobes, while functional neuroimaging studies have shown that stimulating the vestibular cortex can activate the temporal and parietal lobes as well as partially activating the frontal lobe. Although the direct relationship between vertigo and the frontal lobe remains unclear, several studies have noted that vertiginous epilepsy is associated with an impairment in the frontal lobe (such as the anterior cingulate gyrus, precentral gyrus, inferior frontal gyrus, and middle frontal gyrus). Moreover, Kahane et al. reported that vestibular symptoms (including illusions of rotation and indefinable feelings of body motion) can be electrically induced in the frontal lobe. These findings suggest that the frontal lobe may be involved in vestibular function. Additionally, several studies have also proposed that vertigo may be caused by disturbances of ocular movement, as a result of frontal lobe impairment. Relevant animal experiments have demonstrated that the anterior cingulate gyrus and Brodmann area 6 represent the frontal vestibular cortex. Multiple patients have presented with episodes of epileptic rotational vertigo without nystagmus, in which video electroencephalogram results revealed a frontal onset of epileptic discharges, and magnetic resonance imaging revealed a lesion in the frontal lobe, supporting the aforementioned hypothesis.

Several scholars have proposed the concept ‘vestibulogenic seizures.’ This condition is thought to represent an idiopathic subtype of epileptic seizures with a benign clinical course and a potential familial inheritance. However, epilepsy with vestibular symptoms usually manifests as a disturbance of motion and perception, an ocular movement disorder, or a proprioception deficiency; nevertheless, epilepsy presenting with vestibular vertigo alone is extremely rare. Recently, two cases were reported of idiopathic epilepsy with vertigo as the sole onset symptom. The patients in both of these cases had a family history of epilepsy and responded well to anti-epileptic therapy. Notably, the patient in the current case presented with general tonic–clonic seizures, which is consistent with previous reports that approximately 23% of all vestibulogenic seizures manifest as general tonic–clonic seizures. To our knowledge, this is the first reported case of idiopathic epilepsy with vertigo as the sole onset symptom. After antiepileptic treatment with combined sodium valproate, levetiracetam, and lamotrigine, the patient’s frontal lobe epilepsy was well controlled. Previous research has reported that lamotrigine has significant efficacy for the control of vestibulogenic seizures, and can help to prevent the recurrence of such seizures. However, the current evidence is limited to single case reports and short-term follow-up periods. Thus, the definitive pathogenesis of vestibulogenic seizures, as well as the optimal treatment options, require further research based on large-sample cohorts.

In conclusion, our findings expand the symptom spectrum of epilepsy, suggesting that vertigo can be an uncommon clinical manifestation of frontal lobe epilepsy. Although the pathological correlation
between vertigo and epilepsy remains elusive, our findings indicate that vestibular cortical neurons may participate in periodic epileptiform discharges of the frontal lobe. Clinicians should be aware of a potential diagnosis of epilepsy in patients presenting with vertigo as the onset symptom because this condition is usually underdiagnosed.

Declaration of conflicting interest
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Supplemental Material
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