Pearls & Oy-sters: Parietal Lobe Epilepsy in Disguise

Motor Attacks Induced by Proprioceptive Triggers

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Pearls

- Parietal lobe epilepsy (PLE) is characterized by frequent auras and diverse semiologies, largely due to the elaborate connections of the parietal lobe to other regions.
- Proprioceptive-induced seizures are a rare but unique expression of PLE. They are characterized by motor seizure attacks precipitated by proprioceptive stimuli of the extremities.
- Focal cortical dysplasia (FCD) is a common etiology of drug-refractory PLE. Bottom-of-sulcus dysplasia (BOSD) represents a distinctive subtype notable for its highly localized and subtle lesions, as well as an excellent surgical outcome.

Oy-sters

- PLE should be part of the differential in patients with paroxysmal movement disorders. Thorough history taking, especially of the triggers and motor attacks, is essential for a correct diagnosis.
- The presence of localized rhythmic epileptic discharges (REDs) on electroencephalography serves as an important indicator of the easily misdiagnosed FCD. A thorough history taking, careful review of MRI, and application of multimodal imaging postprocessing further facilitate subtle lesion detection.
- A transient response to antiseizure medications is common in FCD-associated epilepsy. However, early referral to surgery evaluation should be considered because drug refractoriness is likely to develop with time.

Case Report

A right-handed 10-year-old boy presented with recurrent movement-induced seizure attacks for several months. He described most of the episodes as a tingling sensation moving upward from the left foot to the left face, occurring over seconds. This was sometimes followed by dystonia of the left upper and lower extremities. The attacks were consistently provoked by walking, running, rubbing of his left foot, or simply by stepping onto an uneven ground. The patient and his parents were unaware of the family history with such attacks and declined genetic testing. Brain MRI and 24-hour EEG were negative. He was diagnosed with paroxysmal kinesigenic dyskinesia (PKD) and placed on carbamazepine and valproic acid at another medical institution. He remained relapse free for around 1 year but began experiencing focal to bilateral tonic-clonic seizures (FBTCSs) roughly twice a year. He also reported frequent movement/rubbing-induced focal seizures up to once per week. He was diagnosed with epilepsy.

Despite an optimal therapeutic dosing level, the patient recalled an increasing seizure frequency, with almost daily focal seizures and FBTCSs roughly once every 3 months. Thinking his disease was incurable, the patient discontinued all medications at age 36 years. Attack

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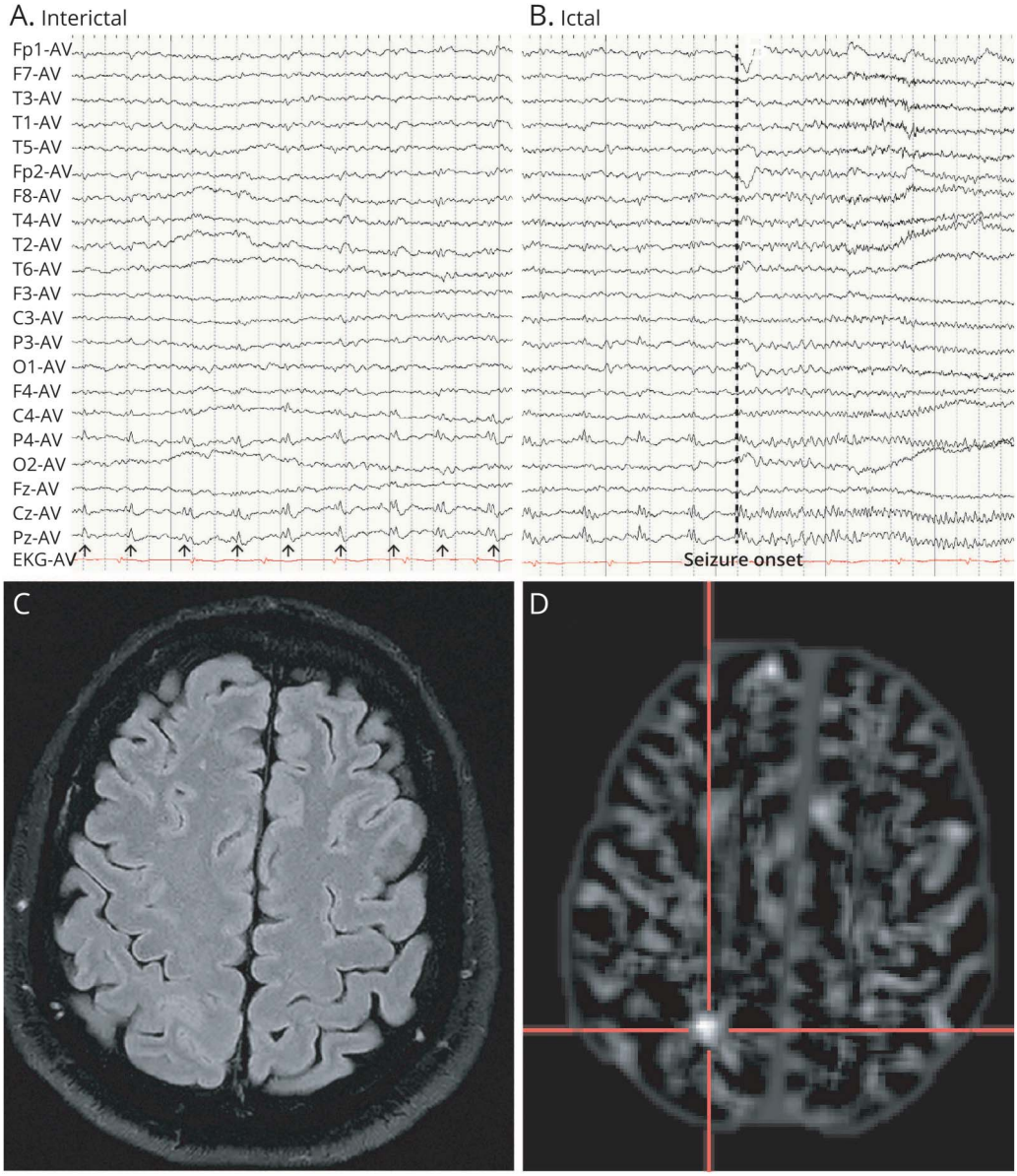
Figure 1 Electrical-Radiologic Features of the Patient With Proprioceptive-Induced Epilepsy Related With Bottom-of-Sulcus Dysplasia (BOSD) in the Superior Parietal Lobe



(A) Sample interictal EEG (time base 30 mm/sec, sensitivity 10 μV/mm) showed rhythmic epileptiform discharges (REDs, with arrows) over the right centroparietal region. (B) Ictal EEG (time base 30 mm/sec, sensitivity 10 μV/mm) showed RED with an increasing frequency, followed by fast epileptiform discharges over the right centroparietal region. The dashed line marked the seizure onset when the clinically observable epileptic symptoms (tonic posturing of the left leg) began. (C) Reexamination of the high-resolution MRI showed subtle cortical thickening maximal at the bottom of the postcentral sulcus. (D) Voxel-based morphometric MRI postprocessing further revealed abnormalities at the depth of the postcentral sulcus, part of the postcentral gyrus, and the superior parietal lobule.

frequency increased significantly, with multiple focal seizures per day and FBTCSs up to once a week. The patient even became afraid of walking because it always led to falls. He came to our clinic and was admitted to the epilepsy unit for evaluation of surgical eligibility.

The patient underwent high-resolution MRI (eFigure 1, A–C, links.lww.com/WNL/B790) and interictal PET, both of which reported normal. Three days of video-EEG monitoring captured more than 20 episodes of focal seizures ranging from 10 to 30 seconds. Seizures were elicited or exacerbated by voluntary scratching of the left foot. Semiology consisted of auras presenting as sensory Jacksonian march on his left side, sometimes followed by tonic posturing of the left extremity. The patient was aware throughout the attack. On tapering of carbamazepine, 2 episodes of FBTCSs were captured, both of which were preceded by unconscious leg movements during sleep.

The awake and sleep EEG background were normal. On his interictal EEG, intermittent REDs were dominant in the right

Table Key Differentiating Features in Parietal Lobe Epilepsy vs Paroxysmal Kinesigenic Dyskinesia

	Parietal lobe epilepsy[3,5,6,9]	Paroxysmal kinesigenic dyskinesia[14]
Proposed origin	Parietal lobe	Extrapyramidal system (basal ganglia)
Onset	Childhood or adults	Childhood
Triggers	Active or passive movements (due to changes in proprioception sensations)	Active movements
Paroxysmal motor attacks	Stereotyped (lateralized, with auras, with impaired awareness)	Variable
Focal-to-bilateral tonic-clonic seizures	Frequent	None
Family history	Mostly sporadic	Familial clustering
Interictal EEG	Spikes/sharp waves (often nonlocalizing)[3]	Normal
Ictal EEG	Ictal localizing patterns observed in 10%–40%[3,4]; nonlocalizing epileptiform discharges common	Normal with muscle artifact
Structural MRI	Structural anomalies (likely to be interpreted as normal)	Normal
Genetic testing	Normal or epilepsy-associated variants	Normal or PRRT2 variants
Prognosis	Drug refractory	Controlled with low-dose antiepileptics

Abbreviation: PRRT2 = proline-rich transmembrane protein 2.

centroparietal region (P4, Pz, and Cz) (Figure 1A). During a habitual attack, more frequent REDs over the right centroparietal region were noted, corresponding to somatosensory auras. It was followed by right-sided focal fast epileptiform activity associated with tonic posturing of the left leg. FBTCSs were accompanied by focal fast activity in the right centroparietal region, followed by generalized spike and waves on EEG (Figure 1B).

Despite initial negative MRI reports, we still suspected abnormalities posterior to the central sulcus given the semiology and EEG findings. During the multidisciplinary presurgical conference, we reexamined the high-resolution MRI with a special attention to the postcentral area. Subtle cortical thickening maximal at the bottom of the sulcus was suspected (Figure 1C). Voxel-based MRI postprocessing further confirmed abnormality maximal at the bottom of the postcentral sulcus (Figure 1D). PET-MRI coregistration showed mild hypometabolism over the same area (eFigure 1D, links.lww.com/WNL/B790). Considering the lesion's proximity to eloquent areas (the sensorimotor cortex and the superior parietal lobule), intracranial electrode implantation was performed.

Stereoelectroencephalography recorded several of his habitual seizures, revealing an intralesional and perilesional ictal onset (Video 1). Near-total en bloc resection of the lesion, tailored with electrocorticography recording, was performed (eFigure 2, A–B, links.lww.com/WNL/B790). Tissue histopathology (eFigure 2, C–D) confirmed FCD type IIb, showing dysmorphic neurons and balloon cells along the gray-white matter junction, as well as mild dyslamination of cortical neurons. The diagnosis of bottom-of-sulcus dysplasia (BOSD) was given. After surgical resection, rubbing or movement of the left foot no longer induced seizure attacks. He was free of habitual seizures at the last follow-up (6 months postoperatively). No weakness or sensory loss was reported. He was maintained on a stable dose of carbamazepine and valproic acid after surgery.

Discussion

PLE is a rare syndrome constituting less than 5% of focal epilepsies.[1,2] It is notoriously known as the great imitator, remarkable for its diverse semiologies and a low diagnostic yield on ancillary studies.[3] Auras, present in over 60% of patients with PLE, include lateralized somatosensory sensations, nonspecific anxiety, vertigo, or visual disturbances.[4-7] The various auras often mislead clinicians to other diagnoses, such as psychogenic nonepileptic seizures, transient ischemic attacks, and migraines. The subsequent semiologies in PLE are diverse as well, given the elaborate connections of the parietal lobe to frontal, temporal, or occipital lobes.[4] Generally, inferior parietal lesions manifest with complex semiologies associated with a preferential spread to temporo-limbic areas.[6] By contrast, lesions in the superior parietal lobe have a diverse propagation network, often projecting to the premotor cortex and supplementary sensorimotor area and presenting with somatosensory auras and subsequent tonic posturing,[6,7] as seen in our patient.

Our case is also notable for motor attacks induced mainly by proprioceptive triggers. Such seizure attacks were first documented as proprioceptive-induced seizures in the early 1900s,[8] which strongly indicated parietal lobe involvement. The proprioceptive input serves as an important afferent to the postcentral area in PLE, triggering the spread of seizures.[8] However, 1 important challenge of proprioceptive-induced seizures is the differential from paroxysmal movement disorders. The proprioceptive triggers in patients with epilepsy can be described as passive or active movement of the extremities,[8,9] misleading clinicians to other diagnosis such as PKD. Key points helpful for the differentiation between PLE and PKD are summarized in the Table. In particular, careful investigation of the specific triggers and description of each attack are important. Lateralization of the semiologies, presence of auras, attacks with impaired awareness, and unsatisfactory long-term drug response would favor a diagnosis of PLE. A nonrevealing EEG or MRI could not exclude the diagnosis of epilepsy, given their low diagnostic yield in PLE.[4] A thorough history taking and physical examination are informative under these circumstances.

FCD is a frequent etiology for drug-refractory PLE.[4,7] In our patient, the highly localized RED on EEG served as an important diagnostic clue.[10] RED refers to stereotyped, rhythmic sequences of sharp waves or spikes lasting >1 second.[11,12] This EEG finding was first proposed in 1996 as a biomarker for FCD,[11] with a sensitivity of 40%–50% and a specificity of 95%–100% on scalp EEG.[12] Recognition of the EEG biomarker led us to reexamine the high-resolution MRI in search of the lesion. In particular, our patient had a highly localized subtype of type II FCD, BOSD, known for its drug refractoriness but excellent surgical outcome.[10] BOSD can be easily missed given its subtle abnormalities on MRI, including cortical thickening, gray-white junction blurring, and subcortical hyperintensity maximal at the depth of the sulcus. MRI postprocessing and PET-MRI coregistration further assisted in identifying the lesion and increased confidence in surgical intervention.

One caveat further blurring the differential between PKD and PLE is the responsiveness to antiseizure medications (ASMs) in both groups of patients. For PLE caused by FCD, 17%–44% experienced a transient seizure remission with ASMs, either after initial treatment or later in the disease course.[13] Up to 90%–100% of patients with PKD had a complete response to sodium channel blocking ASMs such as carbamazepine, especially those with *PRRT2* variants.[14,15] However, despite the temporary response to ASMs, most patients with FCD become drug refractory at length.[13] Therefore, continued monitoring of drug responsiveness is essential for both a correct diagnosis and optimal therapeutic strategy.

In summary, we report a case of PLE in the context of FCD, who presented as proprioceptive-induced seizures and was initially misdiagnosed as PKD. PLE should be considered in patients with paroxysmal movement disorders to prevent delayed diagnosis. We also highlight FCD as a major cause of drug-resistant PLE. The EEG biomarker and neuroimaging features were discussed. Recognition of the underlying cause of PLE facilitates early identification of optimal candidates for surgical treatment.

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Disclosure

The authors report no disclosures relevant to the manuscript. Go to Neurology.org/N for full disclosures.

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