

Case report

Surgical outcome of gelastic epilepsy of frontal lobe origin: A case report

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ABSTRACT

Gelastic seizure is an uncommon type of seizure which is characterized by recurrent bouts of unprovoked and stereotyped laughter. It is commonly observed in patients with hypothalamic hamartoma, while its association with other cerebral lesions is rare. The patient was a 15-year-old right-handed male. His chief complaints were recurrent onsets of laughter and unconsciousness for 10 years. On average, he had several to dozens of onsets per day and had failed most antiepileptic medications before admission. Presurgical evaluation included MRI, video-EEG, MEG and subdural electrode EEG. The results of MEG and subdural electrode EEG suggested that the epileptogenic focus was located on the lateral surface of the right frontal lobe, chiefly on the anterior part of the inferior frontal gyrus. The focus was removed under intraoperative ECoG monitoring which was consistent with the results of MEG and subdural electrode EEG. Histopathology revealed focal cortical dysplasia with balloon cells (type II). The patient kept seizure-free during the short-term follow up of 3 months. In the past literature, the medial frontal and basal temporal lobes, besides the hypothalamus, were thought to play major roles in the case of gelastic seizure. Our results suggest that the lateral surface of the frontal lobe might also be one part of the epileptogenic network in gelastic seizures. Removal of the epileptogenic focus under thorough pre-surgical evaluation might result in good seizure control in patients with gelastic seizures.

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1. Introduction

Gelastic epilepsy is a rare seizure disorder characterized by unprovoked, stereotyped, uncontrollable paroxysmal laughter, which accounts for less than 1% of all epilepsies.¹ Although the pathological substrate of most gelastic seizures is hypothalamic hamartoma, some reports have shown it could also be caused by cortical epileptogenic focus in frontal or temporal lobe.^{1–3} Most cortical gelastic epilepsies are associated with temporal lobe pathology: Tassinari's research has shown in 60 patients suffering from gelastic seizure without hypothalamic hamartomas, 37 patients had a suspected or proven temporal epileptogenic focus, while only 6 had a frontal focus. Many of these patients had focal pathology such as tumors, encephalomalacia, or hemispheric atrophy.⁴ Surgical treatment has significant effects on gelastic seizure associated with hypothalamic hamartoma while pharmacotherapy has not.⁵ But fewer data are available on the response to

surgical interventions in gelastic epilepsy caused by cortical epileptogenic focus.

In the present study, we report a case of gelastic seizure without hypothalamic hamartoma. Magnetic resonance imaging (MRI), video-electroencephalography (EEG), magnetoencephalography (MEG) and subdural electrode EEG were used to localize the epileptogenic focus. We also describe the detail of surgical procedure, pathological findings and results of short-term follow-up.

2. Case report

A 15-year-old right-handed male suffering from a 10-year history of ictal laughter and unconsciousness was admitted to our institution. The seizures were characterized by laughter with or without giggling, and accompanied by unawareness, automatisms including lip smacking and hand picking. He could not recall any sensory auras prior to the seizures. The feeling of mirth or postictal confusion did not occur. The duration of each episode was about 1 min. Most seizure onsets occurred at the early stage of sleep. The initial seizure frequency was approximately once every 3 or 4 days. With the disease deteriorating, the frequency increased to several times per day. The epilepsy was refractory to antiepileptic drugs

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including sodium valproate, carbamazepine, oxcarbazepine and topiramate. Thus the patient came to our institution for presurgical evaluation.

The patient was a middle school student with normal academic performance: His language, calculation and memory abilities were similar to his peers'. The Wechsler Intelligence Scale for Children-China revised test⁶ showed his verbal IQ, performance IQ and full-scale IQ score was 94, 101 and 97, respectively. His past and family history was unremarkable. Physical and neurological examinations were normal. High resolution cranial MRI (T1 and T2 weighted imaging, with 1.5-mm-thick sections in the axial, coronal, and sagittal planes by using 3.0-tesla scanner) was negative. During 24 h of video-EEG monitoring, two episodes of gelastic seizure were observed. Interictal spikes and sharp waves in the right temporal and frontal regions were recorded, especially in the

temporal region (Fig. 1A). Ictal EEG showed pre-ictal sharp-wave like rhythm in the right temporal region with subsequent unilateral spreading during ictal episodes (Fig. 1B). Interictal MEG was recorded using 151-channel whole-cortex MEG scanner. The magnetic source imaging (MSI) indicated that the epileptogenic focus was located in the anterior part of inferior frontal gyrus (Fig. 2). Since the findings of video-EEG and MEG were not consistent with each other, subdural electrode EEG was used to localize the epileptogenic focus. After right frontotemporal craniotomy, a 32-channel grid electrode was placed on the lateral surface of the frontal and temporal lobes, three strip electrodes (6-, 8- and 6-channel) were placed on the basal surface of temporal lobe, basal and medial surface of frontal lobe, respectively (Fig. 3). A total of 4 episodes of gelastic seizures were recorded during 192 h of video-EEG monitoring. Interictal spike-and-slow waves

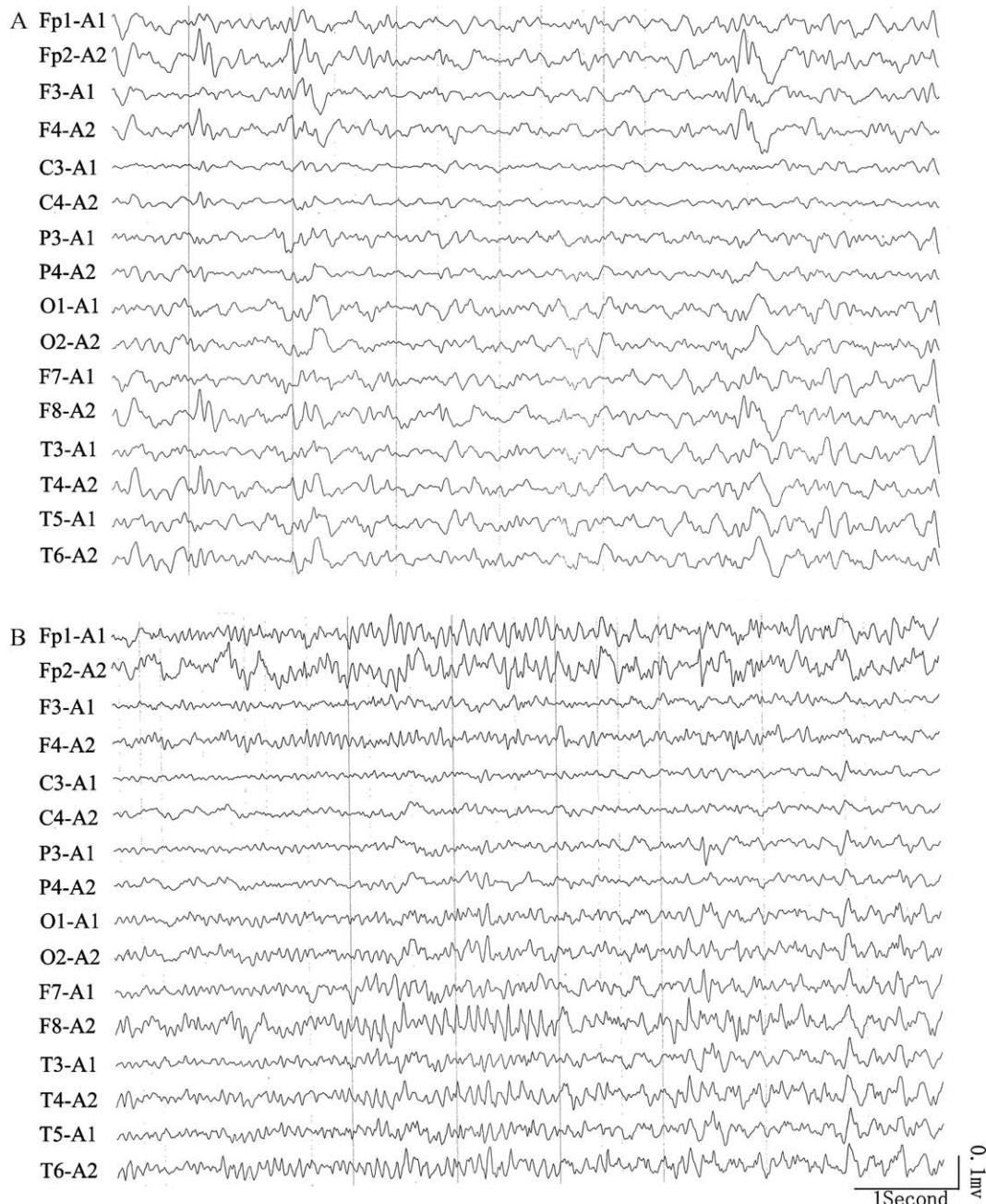


Fig. 1. (A) Interictal scalp video-EEG shows spikes and sharp waves in the right temporal and frontal regions, especially in the temporal regions. (B) Pre-ictal sharp-wave like rhythm in the right temporal regions.

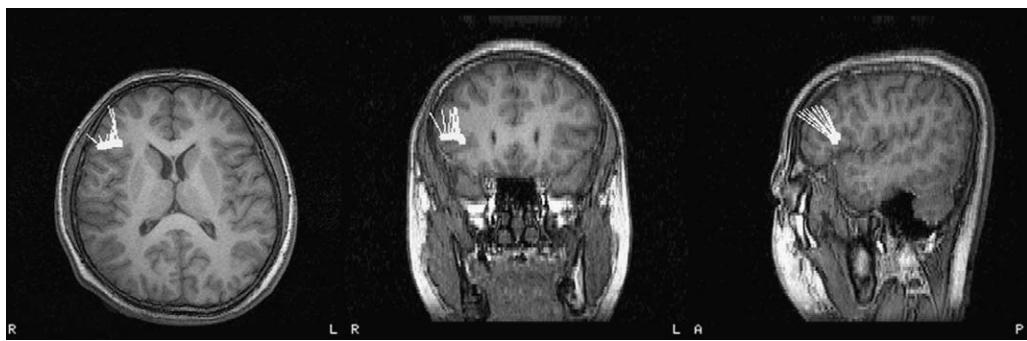


Fig. 2. MSI shows the epileptogenic focus is located in the anterior region of inferior frontal gyrus.

were observed frequently on the lateral surface of the frontal lobe (Fig. 3) and repetitive ictal spikes and spike-and-slow waves were shown in the same region (Fig. 4). Since there was sufficient evidence to localize the epileptogenic focus, electrical stimulation was not performed during subdural EEG monitoring.

Based on the results of MEG and subdural electrode EEG, we postulated the epileptogenic focus was located on the lateral surface of the frontal lobe. The same craniotomy was performed to remove the epileptogenic focus. Intraoperative electrocorticogra-

phy (ECoG) was used to confirm the site and size of the epileptogenic focus and record the neuroelectrophysiological changes which might predict the prognosis. Intraoperative ECoG showed repetitive spikes in the anterior part of inferior frontal gyrus which confirmed the results of MEG and subdural electrode EEG and this area was removed accordingly. Spikes reduced significantly after the resection. Postoperative MRI showed the site and size of resection (Fig. 5). Histopathology revealed focal cortical dysplasia (FCD) with balloon cells (type II). The patient kept

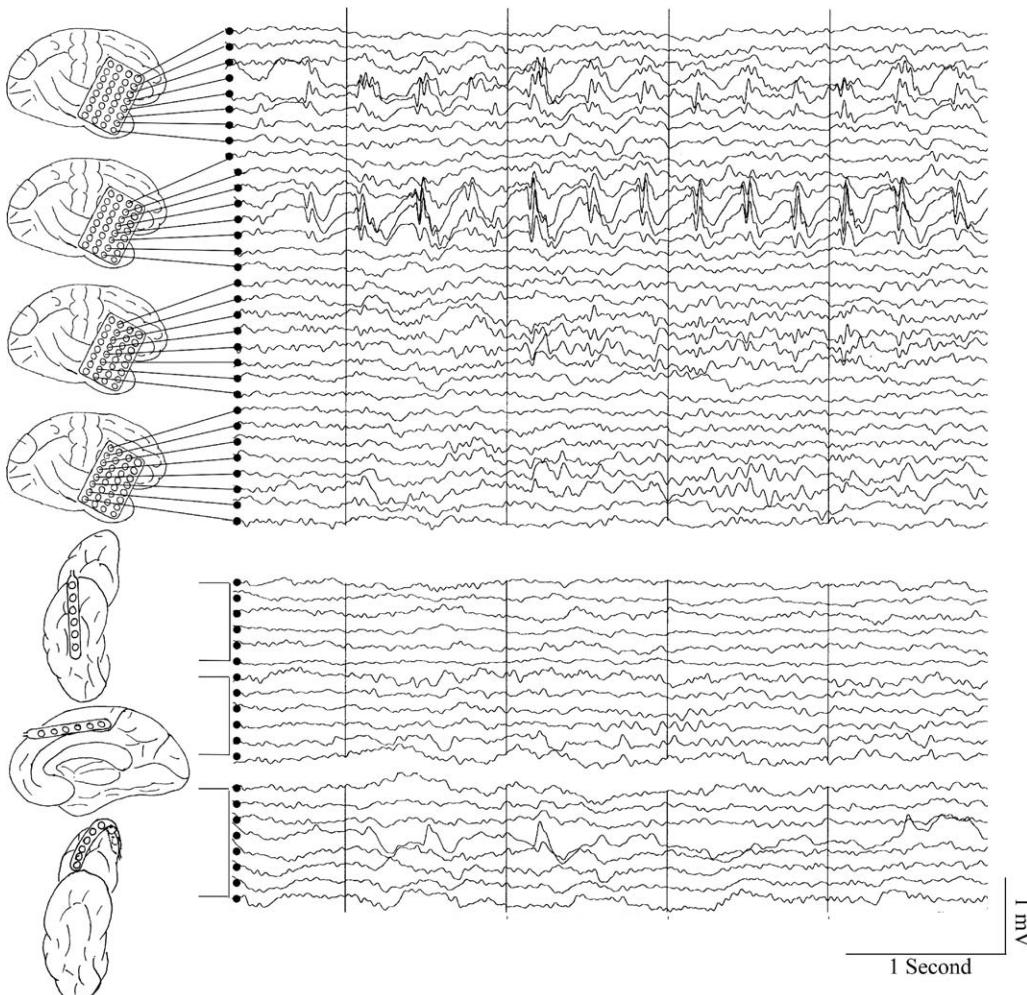


Fig. 3. Interictal subdural electrode EEG shows spike-and-slow waves occur frequently on the lateral surface of the frontal lobe.

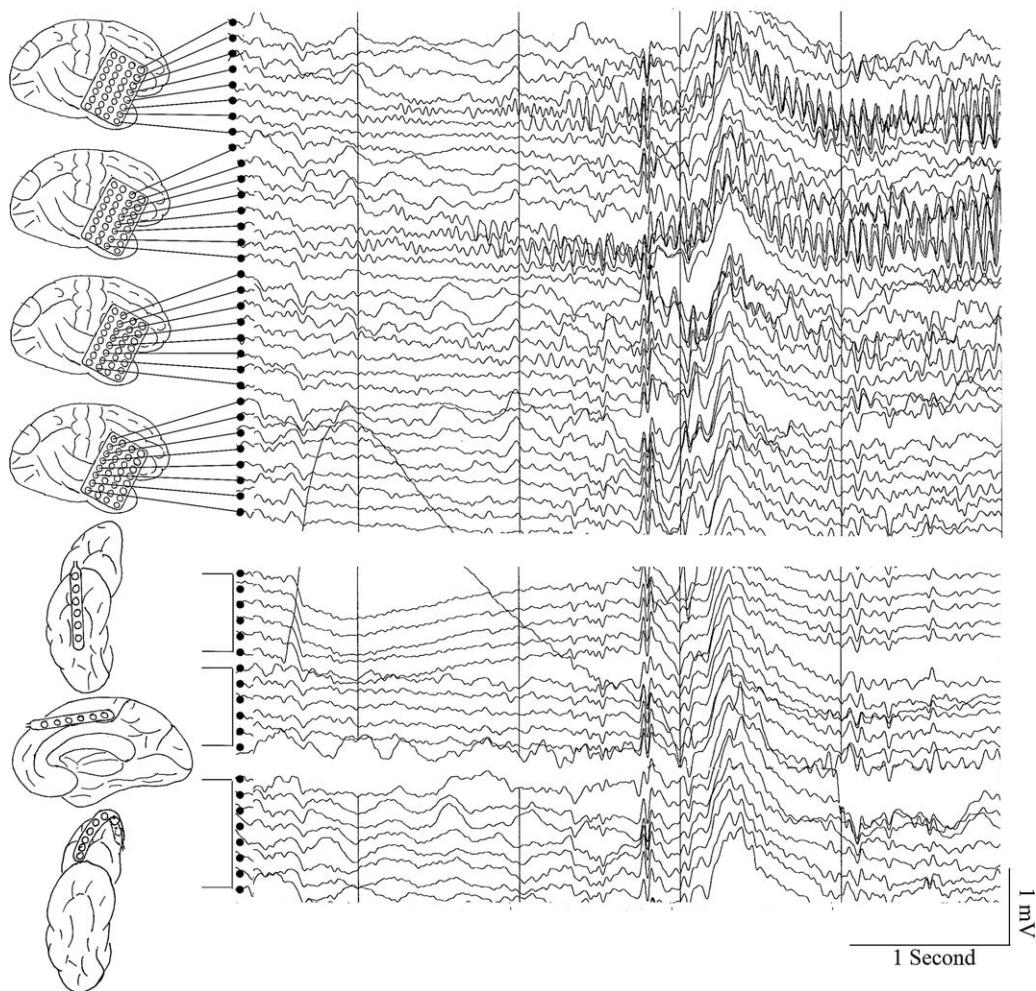


Fig. 4. Ictal subdural electrode EEG shows repetitive spikes and spike-and-slow waves occur on the lateral surface of the frontal lobe.

seizure-free during the short-term follow up of 3 months with Oxcarbazepine 1200 mg per day. No residual spike waves were observed during 24 h video-EEG monitoring.

3. Discussion

Symptomatic gelastic epilepsy, secondary to cerebral lesions apart from hypothalamic hamartoma, is very rare. Since most patients cannot achieve good seizure control with various anti-epileptic medications, surgical interventions might be alternative treatment modalities for them. Although there have been only

sporadic reports of cortical lesion-related gelastic seizures treated surgically, excellent postoperative outcomes were achieved.^{2,7,8}

It has been reported that normal laughter is associated with several different brain structures: the frontal, temporal and temporobasal cortex; the limbic system; the primary sensory and sensory association areas; and the brainstem.^{2,9} Pathological laughter occurs in conditions of pseudobulbar palsy, emotional lability, behavioral disinhibition and gelastic seizures.² The clinical manifestations and EEG findings of our patient coincide with the diagnostic criteria for gelastic epilepsy. Since different brain structures are involved in normal laughter, the origins of gelastic seizure are various. The most frequently reported epileptogenic

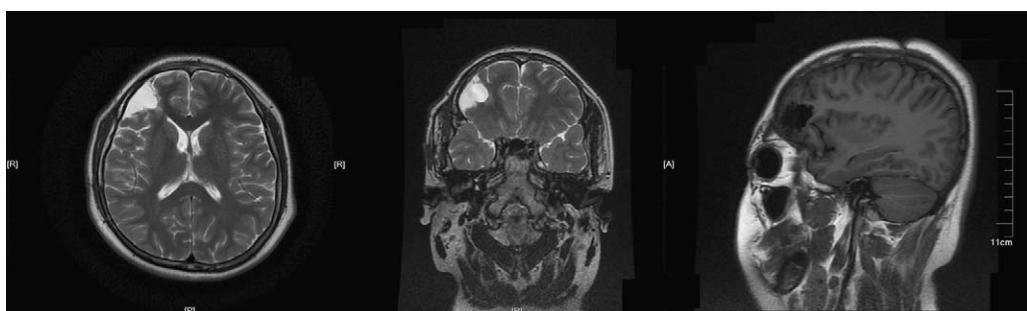


Fig. 5. MRI shows the site and size of surgical resection.

foci were located in the frontal and temporal lobes apart from hypothalamus. Different origins of gelastic seizure may account for the variety of accompanying clinical manifestations. In the previous literature it was suggested that the onsets of gelastic seizure caused by hypothalamic hamartoma typically present before 5 years of age while that of cortical gelastic seizure occur after the age.⁴ Not only do the hypothalamic and cortical gelastic seizures present different clinical manifestations, but also the temporal and frontal originating gelastic seizures have different clinical patterns: In contrast with gelastic seizure originating from temporal lobe, the clinical pattern of gelastic seizure with frontal origin seems to be essentially uniform. Their laughter appears to be unmotivated from the observer's perspective and subjective mirth is absent.^{10,11} Arroyo et al. suggested that the occurrence of subjective mirth might be the indication of temporobasal cortex involvement.² Iwasa et al. reported that the hippocampal regions might be involved in the generation of the feeling of mirth and the cingulate be associated with the motor act of laughter.¹² The clinical manifestations of our case are in agreement with those of frontal originating gelastic epilepsy: His laughter seems to be "forced" and he did not feel mirth during the ictal episodes. Of the previously reported gelastic seizure cases associated with frontal epileptogenic zone, seizure activities were localized to the anterior or dorsal cingulated region or the dorsolateral convexity,¹¹ while the anterior part of the inferior frontal gyrus has never been reported. The outcome of our patient showed some evidence that this area might also be involved in epileptogenic network in gelastic seizures.

To our present knowledge, there was no available literature reporting the use of MEG to localize the epileptogenic focus of gelastic seizure. Although not a routine technique, MEG can provide useful noninvasive evidence for the localization of epileptogenic focus. Most studies suggest that MEG seems to be more sensitive for superficial epileptogenic foci than for deep ones.^{13,14} Our case is in great agreement with this conclusion: MEG not only detected the interictal spikes originated from the lateral surface of the frontal lobe, but also provided accurate localization of the epileptogenic focus.

The histopathological findings from previous literature on gelastic seizure associated with cortical lesions are various: tumor, encephalomalacia, cavernous haemangioma and FCD.^{2,4,15} In our case, histopathology revealed FCD with balloon cells (type II). Evidence across several centers has shown that the rates of seizure-freedom one year after FCD surgery are about 80%.¹⁶ Our

patient kept seizure-free during the short-term follow up of three months. We postulate that complete resection of cortical lesions associated with gelastic seizure might result in good seizure control.

4. Conclusions

1. The lateral surface of the frontal lobe might also be one part of the epileptogenic network in gelastic seizures.
2. Removal of the epileptogenic focus under thorough pre-surgical evaluation might result in good seizure control in patients with gelastic seizures.

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