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Case report

Diagnosing nocturnal frontal lobe epilepsy: A case study of two children

Yuko Tomonoh [a], Sawa Yasumoto [a], Yukiko Ihara [a], Takako Fujita [a], Noriko Nakamura [a], Shinya Ninomiya [a], Rie Kodama [a], Hiroshi Ideguchi [a], Takahito Inoue [a], Akihisa Mitsudome [b], Shinichi Hirose [a,*]

[a] Department of Pediatrics, School of Medicine, Fukuoka University, 45-1, 7-chome, Nanakuma, Jonan-ku, Fukuoka 814-0180, Japan
[b] International University of Health and Welfare, Okawa, Japan

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ABSTRACT

We describe two children of nocturnal frontal lobe epilepsy (NFLE) diagnosed using carefully observed nocturnal sleep EEGs and detailed patient histories.

Case #1, a 14-year-old boy, showed repeated generalized tonic convulsions and frequent eyes opening seizures during sleep. Conventional EEGs – done with the patient awake or in sleep stage I – showed no abnormalities, while a nocturnal sleep EEG – done during in sleep stage II – revealed the repeated, sharp wave bursts predominantly in the right frontal lobe characteristic of NFLE. During these wave bursts, we noticed the boy's eyes opening, although his parents had not been aware this NFLE symptom.

Case #2, a 12-year-old boy, showed one daytime generalized convulsion. He had also been suffering from repeated paroxysmal episodes similar to parasomnia – waking up, sitting, walking, screaming, and speaking – which always followed the same patterns lasting several minutes. During the nocturnal sleep EEG, episodes occurred twice, showing abnormal epileptic discharges predominantly in the frontal lobe. His parents did not mention the episodes to us until questioned, as they had recognized them as parasomnia. The previous conventional EEG showed abnormal slow waves in the frontal lobe, which led us to suspect frontal lobe epilepsy and to take a detailed patient history.

The frequency and stereotypy of their symptoms during sleep caused us to perform nocturnal sleep EEGs and led us NFLE diagnosis. Detailed patient histories including sleep habits and carefully observed nocturnal sleep EEGs enabled us to recognize these NFLE clinical features.

1. Introduction

Nocturnal frontal lobe epilepsy is a condition which occurs only during sleep and which originates in the frontal lobes.[1,2] NFLE's unusual seizure symptoms often lead to its being confused with non epileptic parasomnia, making nocturnal sleep EEGs with video monitoring reliable method for diagnosing it.

2. Case reports

Case #1 is a 14-year-old boy who experienced – only during sleep – repeated generalized tonic seizures. His interictal conventional EEG findings prior to sleep stage I were normal. The nocturnal sleep EEG we gave him provided evidence for an NFLE diagnosis.

The patient complained of headache and pain in both thighs on waking in the morning, an indication he may have had generalized convulsions during sleep. In the afternoon, again while asleep, he had a generalized tonic convulsion lasting 3 min and was brought to a nearby hospital, where his EEG was taken twice and was normal each time. His brain MRI was also normal and his family had no history of epilepsy or febrile seizures. Four months later, while sleeping, he had another episode of generalized tonic convulsion, this one lasting 2 min. A week after this, because of these seizures, we performed a nocturnal sleep EEG. No abnormality was found during sleep stage I, but 30 min later, beginning sleep stage II, the EEG showed repeated sharp wave bursts predominantly in the right frontal lobe (Fig. 1). The patient's eyes opened half-way during the sharp wave bursts and closed when they ended, lasting several seconds. On the basis of his symptoms and the EEG findings, our diagnosis was NFLE. CBZ was administered and the symptoms and sharp wave bursts ceased.

Case #2 is a 12-year-old boy who, while he had had only one generalized daytime tonic seizure, had experienced nocturnal episodes (somnambulism and night terrors) which led us to administer a nocturnal sleep EEG. Its results led to our diagnosis of NFLE.

* Corresponding author. Tel.: +81 92 801 1011; fax: +81 92 863 1970.
E-mail address: hirose@fukuoka-u.ac.jp (S. Hirose).

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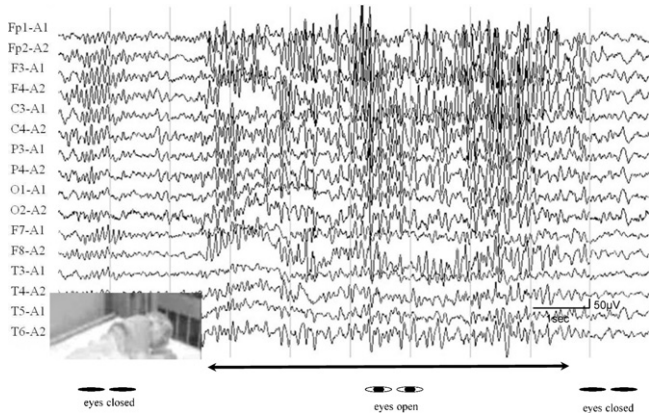

Fig. 1. Case #1's nocturnal sleep EEG. When sleep stage II begins, sharp wave bursts (predominantly in the right frontal lobe) recur repeatedly for several seconds at a time. The patient does not move during the bursts but his eyes open half-way. No abnormalities are seen until sleep stage I.

The patient, at school, had one generalized convulsion lasting 5–10 s. The day following this episode, he was given an interictal awaking EEG in which irregular high voltage slow wave bursts were seen in the frontal lobe, causing us to wonder whether he had frontal lobe epilepsy. We questioned his mother and, surprisingly, found he had been suffering from episodes similar to somnambulism and night terrors. At the age of 11, these episodes occurred a few times a month. One or two hours after falling asleep, he would suddenly wake up, sit, walk a few steps, scream, and then speak. The attacks, which always followed the same pattern, lasted 5 min, during which he was sometimes fearful, sometimes happy. Afterwards, he would fall asleep again, and next morning remembered nothing. At the age of 12, he had such episodes every night. His mother and sister had had febrile seizures in childhood; his grandmother and aunt currently suffer from migraines.

During the nocturnal sleep EEG testing, about 20 min after falling asleep, he suddenly woke, looked around, and said "yes" when his name was called. After about 50 s, he lay down and slept again. Thirty minutes later, he woke again, spoke, and repeatedly made a fist with his right hand. After 25 s, he lay down and slept. When he was in sleep stage II, frontal high voltage sharp wave bursts began 2–3 min before his first episode. Their amplitude increased gradually and 10 s before he awakened frontal high voltage slow waves began. During and after the seizure, frontal irregular high voltage slow waves and sharp wave bursts continued but decreased in frequency, and his sleep returned to sleep stage II (Fig. 2). Similar EEG findings were recorded during the second episode. On the basis of his symptoms and the EEG findings, we diagnosed his nocturnal paroxysmal movements as NFLE seizures. After starting CBZ, auditory side effects began to occur. When ZNS was substituted for CBZ, the side effects stopped and the nocturnal episodes disappeared.

3. Discussion

There are circumstances under which NFLE should always be suspected. Among these are: paroxysmal nocturnal events which occur several times a night; events which persist into post-puberty/adulthood or which exhibit extra pyramidal features; agitated behaviors; and stereotypic attacks.[1,3,4] NFLE seizure symptoms may include sudden nocturnal awakenings or opening of the eyes; the placement of the arms or legs in bizarre postures; frightened or surprised facial expressions; screams; dystonic and tonic postures; and clonic limb convulsions.[1–8]

The clinical features table shows the symptoms which led us to suspect that both Cases #1 and #2 had NFLE and caused us to administer nocturnal sleep EEGs (Table 1). Case #1 had repeated tonic seizures and frequent eyes opening seizures during sleep. The eyes opening in particular occurred many times during sleep stage II. Case #2 had – exclusively during sleep – repeated stereotypic episodes similar to parasomnia. The frequency and stereotypy of

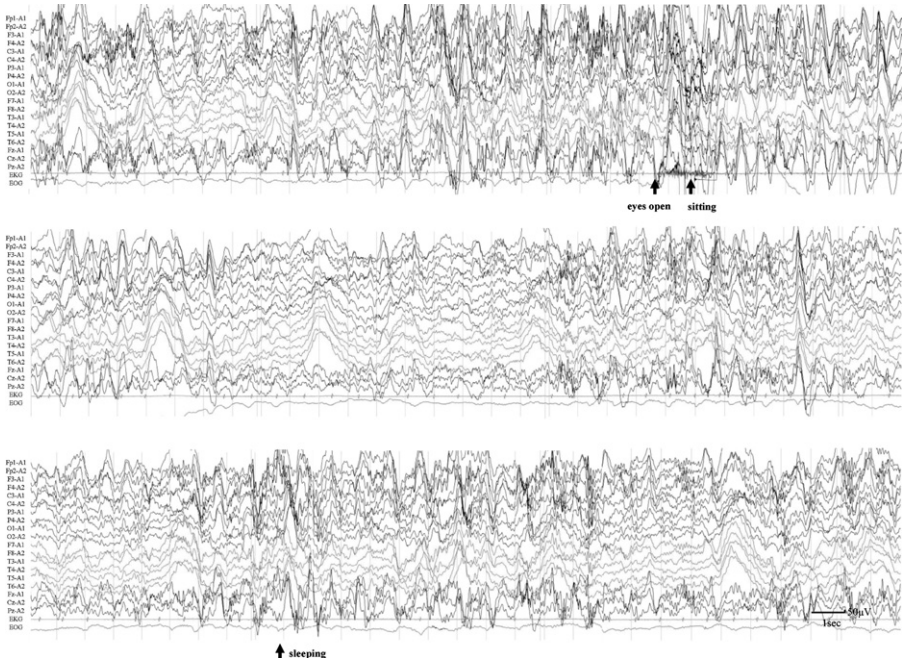

Fig. 2. Case #2's first ictal EEG. Frontal high voltage sharp wave bursts begin during sleep stage II, 2–3 min before the first episode. Their amplitude increases gradually and 10 s before the patient awakens frontal high voltage slow waves begin. During and after the seizure, frontal irregular high voltage slow waves and sharp wave bursts continue but decrease in frequency.

Table 1
Cases #1 and #2 clinical features.

	Case #1		Case #2	
Age at onset	4 years		11 years	
Age at diagnosis	14 years		12 years	
Sex	Male		Male	
Symptoms	Tonic seizures	Eyes opening seizure	Tonic seizure	Paroxysmal movements
Frequency	3 times	10–20 times during sleep stage II	Once	2–3 times per night
Duration	2–3 min	Several seconds	5–10 s	2–5 min
Timing	Within 1 h of sleep	Within 30 min of sleep	Daytime	Within 20 min to 2 h of sleep
Stereotypy	(+)	(+)		(+)

The table shows the clinical features of both cases. The frequency and stereotypy of the boys' symptoms during sleep contributed to our NFLE diagnosis.

the boys' symptoms during sleep contributed to our NFLE diagnosis.

Although these features strongly indicate NFLE, family members were unaware that some of the symptoms were abnormal and, indeed, Case #1's parents had not noticed the frequent eyes opening during sleep. Similarly, Case #2's parents, who had recognized the boy's nocturnal episodes as parasomnia, did not mention them to us until questioned.

When patients with severe or frequent nocturnal events seek medical attention, a detailed patient history is essential; equally important is carefully viewing any video provided by family members of the patient during sleep.[1,3,4] If, however, family members do not recognize paroxysmal sleep events, or consider them normal, they are unlikely to mention them unless, as in our two cases, they are carefully questioned by the attending physician. Accordingly, sleep habit interviews are necessary for all patients showing either daytime or nocturnal seizures. The interviews are particularly important for patients who have abnormal EEGs findings predominantly in the frontal lobes.

Nocturnal sleep EEGs are useful for diagnosing NFLE and distinguishing NFLE from parasomnia. Video monitoring can catch the NFLE symptoms mentioned earlier and also recognize stereotypy.[1] Ictal EEGs can show theta activity, diffuse/focal flattening of background activity, focal theta activity, rhythmic delta activity, spikes, sharp waves, and spike/sharp and wave activity mainly from the frontal lobe.[1,11]

Parasomnic episodes, however, begin when high voltage slow waves expand and end when wave arousal patterns form; during the episodes, EEGs show diffuse δ waves or θ waves without spikes.[9,10] Many NFLE seizures occur during sleep stage II,[1] while parasomnia usually occurs during the first cycle of sleep stage III-IV.

In Case #1, while conventional EEGs – done while the patient was awake or during stage I – showed no abnormalities, a nocturnal sleep EEG – done during sleep stage II – revealed the repeated, sharp wave bursts characteristic of NFLE. We observed him carefully and noticed his eyes opening during these wave bursts.

In Case #2's episode, we recognized dystonic movements of his hands and stereotypy. Case #2's episodes began in the sleep stage II, showing high voltage sharp wave bursts which started 2–3 min before the episode in the bilateral frontal lobes. During and after the seizure, irregular high voltage slow waves and sharp wave bursts continued in the bilateral frontal lobes, and ended in the sleep stage II; that led us to diagnose NFLE.

Another possible cause of NFLE – genetic mutation – was eliminated form considering by testing. Mutations in 2 genes that encode the α4 and β2 subunits of the neuronal nicotinic acetylcholine receptor (*CHRNA4* and *CHRNB2*) have been associated with ADNFLE,[12–15] although they are identified only in a minority of families with this condition.[16] In both Cases # 1 and # 2, we screened all exons of *CHRNA4*, *CHRNB2* and *CHRNA2* using the direct sequencing method, and found no mutations.

4. Conclusion

The frequency and stereotypy of the patients' symptoms during sleep caused us to perform nocturnal sleep EEGs and led us NFLE diagnosis. Our cases showed repeated generalized convulsions, frequent eyes opening seizures, and repeated paroxysmal movements similar to parasomnia. Detailed patient histories including sleep habits and carefully observed nocturnal sleep EEGs enabled us to recognize these NFLE clinical features.

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