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Paroxysmal nonepileptic events in pediatric patients confirmed by long-term video-EEG monitoring — Single tertiary center review of 143 patients

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ABSTRACT

The purpose of the study was to evaluate the clinical characteristics of paroxysmal nonepileptic events (PNEs) in pediatric patients. Reports of 1108 patients who underwent long-term video-EEG monitoring at Seoul National University Children's Hospital were reviewed retrospectively. One hundred forty-three (12.9%) patients were diagnosed as having PNEs. The most common type of PNE was staring. Staring, tonic posturing, sleep myoclonus, and sleep-related disorders were more common in patients younger than 6 years old. Psychogenic nonepileptic seizure was the most common PNE in patients older than 6 years. Patients who were younger than 6 years old showed shorter disease duration and more varied types of PNEs when compared to older patients (6 years old or older). Presence of epilepsy was not significantly related to clinical difference in PNEs. In patients with developmental delay, staring and tonic posture were significantly more frequent than patients without developmental delay. Thirty-two patients without concurrent epilepsy were misdiagnosed with epilepsy, and AEDs were discontinued after the correct diagnosis of PNEs. Whenever the diagnosis of paroxysmal abnormal behavior is uncertain, correct diagnosis should be made using long-term video-EEG monitoring, especially in younger pediatric patients and patients with developmental delay.

1. Introduction

Paroxysmal nonepileptic events (PNEs) are episodes of paroxysmal altered movement, sensation, or experience resembling epileptic seizures. Paroxysmal nonepileptic events are not associated with abnormal electrical discharges in the brain; rather, they are caused by physiologic or psychogenic process [1,2]. The prevalence of PNEs is estimated at 5–20% of the outpatient adult epilepsy population [3], with a lower frequency reported in pediatric patients. Although the frequencies and types of PNEs have been studied extensively in the adult population [4,5], the data available for children and adolescents are more limited [6,7]. Studies addressing PNEs in pediatric patients usually include a majority of patients older than 10 years [8]. Limited information is available on the phenomenology of childhood PNEs according to developmental stage, especially in infants. Although previous studies have reported a high prevalence (5–50%) of PNEs with concurrent epilepsy, there are few data on the demographic and clinical characteristics of patients with PNEs and epilepsy in the pediatric population.

Using long-term video-electroencephalography (EEG) monitoring, we report our experience with PNEs in a pediatric population consisting of various age groups. The clinical characteristics and demographic features of younger patients with PNEs and the differences of PNEs and clinical characteristics between the different age groups were evaluated and compared. The clinical characteristics of PNEs between the patients with or without epilepsy were also compared.

2. Methods

This study was approved by the Institutional Review Board of the Seoul National University Hospital. The reports of 1108 patients who underwent long-term video-EEG monitoring at the Pediatric Epilepsy Monitoring Unit (PEMU) of the Seoul National University Children's Hospital between March 1995 and December 2009 were retrospectively reviewed. Paroxysmal nonepileptic events were diagnosed on the basis of clinical history and long-term video-EEG monitoring.

Medical records were reviewed to collect information regarding sex, age at onset of symptoms, duration of symptoms prior to diagnosis,

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concurrent epilepsy, developmental delay, use of antiepileptic drugs (AEDs), and brain MRI findings.

Scalp electrodes were placed according to the international 10–20 system. Digital video-EEG recordings were obtained by using a Grass Technologies LTM digital EEG system. If additional electromyographic (EMG) findings were necessary, five EMG electrodes were placed on both thighs, both deltoids, and the neck. Three pediatric epileptologists (Kim KJ, Hwang YS, and Hwang H) independently reviewed interictal EEGs and video-EEGs. The monitoring was performed for a minimum of 24 h. Duration of monitoring ranged from 1 to 5 days (mean, 3.2 days and median, 2 days). An episode was not induced in all the cases, and psychogenic nonepileptic seizures were obtained spontaneously in all the cases. Each patient had at least one habitual episode recorded during the study. Patients and their families verified that the recorded episode was a typical and habitual episode. The habitual episode was considered nonepileptic if it was not associated with ictal abnormalities on the EEG.

Certain types of seizures such as simple partial seizures or frontal lobe seizures without EEG correlation were excluded in this study. Diagnosis of the specific type of PNE was based on detailed descriptions from parents and on the typical feature observed during the video-EEG monitoring. Whenever possible, diagnosis was made to the level of specific etiologic entity or disease. If it was impossible to make a certain etiologic diagnosis, PNEs were classified according to the typical manifestations. Hyperkinetic movements such as chorea, dystonia, athetosis, tics, or tremors were classified as movement disorder. Sleep walking, night terrors, confusional arousals, and rhythmic movements other than sleep myoclonus were classified as a sleep disorder. The stereotypic behavior was separated from movement disorder because a large proportion of patients had developmental delays as a comorbid condition. Gastroesophageal reflux was diagnosed with 24-hour esophageal pH monitoring. Only patients with a staring event that was considered as physiologic or organic in origin were classified as 'staring'. Dizziness, headache, or other nonspecific sensory complaints were classified as 'sensory symptoms'.

To assess the relationship between types of PNEs and clinical characteristics of patients, the patients were divided into three groups based on a threshold of 6 years of age (age at the time of monitoring). Group A included patients who were younger than 6 years old, group B included patients who were 6 years old or older but younger than 12 years old, and group C included patients who were 12 years old and older. In addition, the differences between only PNEs and PNEs with concurrent epilepsy were analyzed.

Statistical analysis was performed using SPSS 18.0 for Windows. To compare patient characteristics, the Student t test and Pearson χ^2 test, and ANOVA were used. To compare the clinical characteristics between the different groups, the Pearson χ^2 test and Fisher's exact test were used, based on sample size. Statistical significance was defined as $p<0.05$.

3. Results

After a review of 1108 long-term video-EEG reports, 143 (12.9%) patients (84 boys and 59 girls) diagnosed as having a specific type of PNE were identified. Ninety-one patients were classified into group A, 37 patients into group B, and 15 patients were classified into group C according to the age at diagnosis. The male:female ratio in group A was 1.68:1, 1.1:1 in group B, and 1:1.5 in group C ($p=0.246$). The mean age at the onset of symptoms in group A was 1.4 years (range, 1 day to 5.8 years), 7.0 years (range, 1.2–11.8 years) for group B, and 12.7 years (range, 4.1–18.9 years) for group C. Fifty-five patients (38.4%) were younger than 1 year old, and 11 patients (7.6%) were 12 years old or older at the time of the onset of symptoms. The mean age at the time of diagnosis was 5.0 years (range, 15 days to 19.0 years). Thirty-five patients (24.5%) were younger than 1 year old, and only 15 patients (10.5%) were 12 years old or older at the time of diagnosis. The mean time difference between the onset of symptoms and diagnosis was 0.7 years in group A, 1.4 years in group B, and 1.6 years in group C ($p=0.013$) (Table 1). Between one and four AEDs had been prescribed to 77 patients. Forty-six patients had concurrent epilepsy, and eight out of 46 patients (17.3%) with concurrent epilepsy were younger than 1 year old. One patient in group A was newly diagnosed as having epilepsy after monitoring.

Unnecessary AEDs were prescribed to 32 of 143 patients (22.4%). Antiepileptic drugs were discontinued in 27 (84.4%) of the 32 patients who were deemed (after monitoring) to have been misdiagnosed with epilepsy. Developmental delay was present in 49 of 143 patients (34.3%) ($p=0.016$). Sixty-four of 143 (44.7%) patients had concurrent epilepsy or developmental delay. Brain MRI was performed in 119 of 143 patients, and abnormal MRI results were found in 28 of 77 patients (36.4%) in group A, in 9 of 29 patients (31.0%) in group B, and 6 of 13 patients (46.2%) in group C.

Stratification of PNEs according to age group showed various types of PNEs observed according to the developmental stage. The most common PNE observed was staring (22/143 patients, 15.4%). The second most common PNE was tonic posturing and sleep myoclonus (17/143 patients, 11.8%), followed by movement disorder (16/143 patients, 11.1%), and psychogenic nonepileptic seizure (15/143 patients, 10.5%) (Table 2). An analysis of patients younger than 6 years revealed that staring (16/22 patients, 72.7%), tonic posturing (16/17 patients, 94.1%), sleep myoclonus (10/17 patients, 72.7%), and sleep disorder (9/13 patients, 69.2%) were diagnosed more frequently. Psychogenic nonepileptic seizure (13/15 patients, 86.7%) was the major subgroup of PNEs in patients older than 6 years (Table 2). Based on clinical manifestations, pediatric patients with psychogenic nonepileptic seizure showed two different patterns. One was decreased responsiveness, when the patients became dialeptic with absence or decreased spontaneous movements. Another was excessive motor manifestations, when they brought out motor phenomena such as

Table 1
Demographic and clinical characteristics of patients with paroxysmal nonepileptic events by age group.

	Group A ($n=91$)	Group B ($n=37$)	Group C ($n=15$)	p Value
Sex (male:female)	57:34	21:16	6:9	0.246
Mean age at onset of symptoms (range)	1.4 y (1 d–5.8 y)	7.0 y (1.2–11.8 y)	12.7 y (4.1–18.9 y)	
Mean age at diagnosis (range)	2.1 y (15 d–5.9 y)	8.4 y (6.0–11.9 y)	14.3 y (12.1–19.0 y)	
Mean latency (range)	0.7 y (6 d–5.2 y)	1.4 y (16 d–6.3 y)	1.6 y (3 d–9.0 y)	0.013
AED prescription before diagnosis (%)	54 (59.3)	16 (43.2)	7 (46.7)	0.213
Concurrent epilepsy (%)	32 (35.2)	8 (21.6)	6 (40.0)	0.261
Unnecessary AED (%)	23 (25.3)	8 (21.6)	1 (6.7)	0.274
Developmental delay (%)	39 (42.9)	7 (18.9)	3 (20.0)	0.016
Abnormal brain MRI findings[a] (%)	28 (36.4)	9 (31.0)	6 (46.2)	0.639

AED, antiepileptic drug.
Latency, time difference from symptom onset to diagnosis.
[a] The total number of brain MRIs performed in this study was 119 (77 patients in group A, 29 patients in group B, and 13 patients in group C).