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Clinical features of patients with game-induced seizures in the Chinese population

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ABSTRACT

Purpose: To study the clinical characteristics of patients with game-induced seizures in the Chinese population.
Method: We assessed 51 patients with various game-induced epileptic seizures. Based on whether they had spontaneous seizures, these 51 patients were classified as two groups. Twenty-seven patients who had both game-induced and spontaneous seizures were referred to as Group I, whereas twenty-four patients that had experienced seizures exclusively while playing specific games were assigned to Group II. All of the related clinical data of the patients was collected and evaluated.
Results: The patients in Group I presented with adolescent-onset and related to photosensitive idiopathic generalized epilepsy (IGE), were responsive to valproic acid (VPA) or magnesium valproate (VPA-Mg) therapy, and presented a major seizure-precipitating factor in response to electronic games. While patients in Group II were adult onset and not associated with IGE, showed uncertain responses to VPA and a benign prognosis, and presented major seizure-precipitating factors in response to non-electronic games.
Conclusion: There are obvious genetic differences between patients with game-induced epilepsy. It is necessary to differentiate between various types of game-induced seizures and select the corresponding treatment.

1. Introduction

Reflex seizures can be triggered by various stimuli, such as primary sensory stimuli and complex mental activities. Interestingly, accumulating evidence shows that playing specific games can trigger epileptic seizures, which are referred to as game-induced reflex epilepsy [1].

Non-electronic and electronic games are generally reported to be associated with reflex epilepsy. Non-electronic games include Mah-Jong [2], Chinese chess, and card games. An increasing number of computer games, such as online games, personal computer (PC) games, video games [3], and games on game consoles, belong to the group of electronic games. At present, a considerable number of Chinese individuals, from young children to juveniles and adults were obsessed with playing various games [4].

Few studies concerning video game-induced seizures or other game-induced seizures discussed the clinical features of their cases [1,5,6]. To our observation, a patient with game-induced seizures can experience seizures while playing games or independently of games. Based on whether spontaneous seizures coexisted or not, patients with game-induced seizures can be divided into two groups [7]. Patients who experienced seizures induced not only by a particular game but also independently of a game were assigned to one group. Whereas patients who experienced seizures exclusively triggered by special games without spontaneous seizures were referred to as the other group. From previous reports, we know that with the exception of some pure game-induced seizures, some other related seizures triggered by games are usually a manifestation of the idiopathic generalized epilepsy (IGE) [1,3]. Although some researchers studied game-induced seizures [2,3,5], few studies on the differences between these two groups of game-induced seizures have been conducted.

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In this study, we sought to analyze the differences in clinical features, therapeutic effects and pathogenesis between the two groups of patients with game-induced seizures.

2. Materials and methods

Our study was approved by the Institutional Review Board of Xiangya Hospital, Central South University. It is a retrospective study. Between February 2012 and May 2015, a total of 51 patients with various game-induced seizures were assessed at the Epilepsy Outpatient Clinic of Xiangya Hospital, Central South University, Changsha, China. We obtained clinical data of patients from the medical records and protocol-based interviews performed by one of the authors. Clinical data included the gender, age at seizure onset, personal and family history, specific game of seizure activation, frequency and clinical type of seizures related to or not to the game, any antiepileptic therapy and prognosis. We evaluated the age at onset including both the age at onset of the first game-induced seizure and the age at onset of spontaneous seizure. And the inquiry of the special game that triggered seizure included card game, Mah-Jong, Chinese chess, online game, PC game, video game and console game.

The entry criteria for the patients was that patients must had experienced the seizures precipitated exclusively by playing the specific games at least three times. The exclusion criteria were as follows: (1) alcohol or drug abuse, toxin exposure, infection, or fever induced seizures; (2) vasovagal or cardiogenic syncope. Each patient underwent medical examination, neurological examination, video electroencephalography (VEEG) monitoring and brain magnetic resonance imaging (MRI). Twenty-four hours of prolonged VEEG monitoring involved the international 10/20 system and included awake and sleep stages, photic stimulation, hyperventilation as a provocation.

All of the patients underwent periodic clinical protocol-based follow-up and the length of follow-up ranged from 12 months to 5 years. Based on the coexistence of spontaneous seizures or not during the follow-up period, these 51 patients were classified as two groups. Group I was composed of 27 patients who experienced seizures induced by particular games and independently of games. Group II included 24 patients who experienced seizures exclusively caused by playing particular games. A total of three patients in Group I had a family history of epileptic seizures, and four patients in Group II had preliminary hypertension. The other patients in our study did not have any comorbidities. Most of the patients in our study were obsessed with related games and spent more than 3 h playing related games everyday.

2.1. Statistical approach

Demographic and relevant clinical variables were summarized descriptively to characterize the study population. After testing for the normal distribution of the data, differences between groups were analyzed through either parametric or nonparametric statistics. The statistical analyses were performed using two sample *t*-tests, Pearson's Chi-square test, Fisher's exact test, and the Mann–Whitney U test. All of the tests were performed at a level of significance of 5% ($P < 0.05$). Statistical analyses were conducted using SPSS Version 13.0 (SPSS Inc., Chicago, IL, USA).

3. Results

3.1. Clinical features

The 51 patients were categorized according to the ILAE classification of epilepsies and epileptic syndromes [8] based on details of patients' history, seizure description (seizure at onset, frequency, semiology, precipitating factors and drug response), ictal and interictal VEEG findings and brain MRI findings. Seizure semiology was provided by two witnesses who were usually patients' classmates, colleagues, friends, parents, sisters or brothers.

The demographic and clinical data of the patients in two groups are summarized in Table 1. In Group I, the majority of patients were men (74.07%), aged 12–24 years (mean, 16.0 years), with an age at onset ranging from 7 to 23 years (mean, 13.9 years). The duration of epilepsy ranged from 12 to 60 months (mean, 25 months). In Group II, the majority of patients were also men (75%), aged 31–62 years (mean, 48.4 years), with an age at onset ranging from 30 to 60 years (mean, 46.9 years). The duration of epilepsy ranged from 12 to 27 months (mean, 15 months).

3.2. Clinical seizure patterns and specific reflex activation

In Group I, all of the 27 patients experienced spontaneous seizures independently of games. Sixteen out of twenty-seven

Table 1
Clinical characteristics of 51 patients with game-induced seizures in both Group I and Group II.

	Group I	Group II	*P* values
Number	27	24	
Gender (male/female)	20/7	18/6	N.S.
Mean age at first seizure onset (years)	13.89 ± 3.87	46.92 ± 7.91	<0.001
Mean age at visit (years)	15.96 ± 3.32	48.38 ± 7.99	<0.001
Age composition			
11–20 years	24	0	<0.001
21–30 years	3	0	
31–40 years	0	3	
41–50 years	0	10	
51–60 years	0	11	
Specific games activation			
Electronic games	25	0	<0.001
Nonelectronic games	2	24	
Mean seizure latency (hours)	1.80 ± 1.25	6.21 ± 1.91	<0.001
Game-related seizure frequency (6 months)	2 (2–3)	2 (2–2)	N.S.
Seizure frequency (6 months)	5 (4–6)	2 (2–2)	<0.001
Game-related seizure duration (months)	20 (12–24)	15 (12–24.75)	N.S.
Seizure duration (months)	25 (18–27)	15 (12–24.75)	0.001*
Seizure patterns			
GTCS	16	8	<0.001
PSSG	0	13	
MS and/or ABS, GTCS	11	3	
VEEG			
Abnormal	27	19	0.043*
Normal	0	5	
Brain MRI			
Positive	0	7	0.003*
Negative	27	17	
VPA/VPA-Mg therapy			
Accepted	27	13	<0.001
Refused	0	11	
Effect of comprehensive treatment			
Effective	18	19	N.S.
Ineffective	8	5	

GTCS: Generalized tonic-clonic seizure; PSSG: Partial seizure with secondary generalization; MS: Myoclonic seizure; ABS: Absence seizure; JME: Juvenile myoclonic epilepsy; JAE: Juvenile absence epilepsy; EEG: Electroencephalogram; IEDs: Interictal epileptiform discharges; MRI: magnetic resonance imaging; positive brain MRI: mild brain atrophy; electronic games: online games, personal computer (PC) games, video or television (TV) games, special game consoles; nonelectronic games: Mah-Jong game, Chinese chess, card game; AED: antiepileptic drug; VPA: Valproate; VPA-Mg: Magnesium valproate sustained.
Mean ± SD is used in mean age at first seizure onset (years), mean age at visit (years), and mean seizure latency (hours).
Median (P_{25}–P_{75}) is used in game-related seizure frequency (6 months), and seizure duration (months).
N.S.: no significance $P > 0.05$;
*$P < 0.05$.