

Original Article

Television-Provoked Epilepsy in Children: A Follow-Up Survey from Isfahan, Iran

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Background: Television as an external stimulation can precipitate epileptic seizures. Today this kind of epilepsy is known as television epilepsy. As children spend much of their time watching television, it is important to study this type of epilepsy in this age group. This study was designed to describe the clinical and some demographic characteristics of television epilepsy in Iranian children.

Methods: Patients who were diagnosed as having television epilepsy with an age less than 12 years were recruited from outpatient neurology clinics in Isfahan, Iran, from September 2002 through September 2006. We collected the case-related information including electroencephalograms, radiologic findings, and patients' history.

Results: Thirty patients with television epilepsy with the age less than 12 years were identified. Of whom 17 (56.7%) were females and 13 (43.3%) were males. The mean age at the onset of seizure was 9.9 ± 2.1 years. Children had absence (3.3%), myoclonic (3.3%), and generalized tonic-clonic (93.3%) seizures in response to intermittent photic stimulations. Interictal epileptiform discharges in electroencephalograms were detected in 83.3%. In addition, neuroimaging findings were normal in 96.7% of the patients. In our study, 56.7% of the children had pure television epilepsy and 43.3% experienced other types of generalized seizure. During the follow-up period after initiation of variable drug treatments including valproic acid, carbamazepine, phenobarbital, clonazepam, ethosuximide, and lamotrigine all the patients had complete seizure remission.

Conclusion: The clinical and demographic differences of our patients compared with other reports are probably due to genetic differences. In our study, it was demonstrated that carbamazepine could be used in children with television epilepsy because it had successfully terminated seizures in 43.3% of the patients.

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Introduction

It has long been recognized that in some individuals a wide variety of external stimuli can precipitate epileptic seizures. Today these kinds of epilepsies are known as reflex epilepsies.^{1,2} Nearly 5% of adult and 10% of

pediatric epilepsies are reflex epilepsies.³

Visual stimuli are the most common triggers of reflex epilepsies, which induce photosensitive epilepsies.^{2,4} Epileptic events have been reported to be induced by watching movies since 1900 and by watching television (TV) since the 1950s.^{5,6} TV epilepsy is known to be the most frequent type of photosensitive epilepsy.⁷ Simple visual stimuli such as light or patterns,⁸ or complex visual excitations such as TV programs or video games may trigger visually-provoked seizures in susceptible subjects.⁹

Genetic factors are described to play a role in the incidence of TV epilepsy. In nearly 10% of patients, family history of TV epilepsy is

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positive.¹⁰

There are many reports on seizures induced by TV program contents,¹¹⁻¹³ however, there are controversies over the frequency and some characteristics of the disease.¹⁴ In a study from Srilanka the frequency of photosensitive epilepsy has been reported as the least common among the other kinds of reflex epilepsies,¹⁵ and TV epilepsy was not the most common type of photosensitive epilepsy in contrast to previous studies. Other studies from India and Srilanka reported that the frequency of photosensitive epilepsy was lower in these areas than other parts of the world and genetic factors were thought to be responsible for this difference.^{15,16}

There are some studies on TV epilepsy in children,¹⁷ but there are no reports about TV epilepsy in children from Iran considering the increasing rate of using TV, video games, and computers specially among children who are the most frequent population using these devices in recent years. As a result this survey was designed to study children (<12 years old) with TV epilepsy and their seizure characteristics in Iran where the flicker of the raster scan of TV screens is 50 Hz and genetic differences exist in comparison with the other parts of the world.

Materials and Methods

Patients who were diagnosed as having TV epilepsy with an age less than 12 years were recruited from outpatient neurology clinics in Isfahan, Iran, from December 2002 through December 2006. The diagnosis of TV epilepsy was made by a neurologist according to patient's history of epilepsy triggered by watching TV, electroencephalographic (EEG) findings, and patient's presentation of photoparoxysmal response (PPR) to intermittent photic stimulation (IPS).

The standard IPS test was done according to the protocol of the European expert panel.¹⁸ After the patients have been placed in 30 cm distance from the photic stimulator, separate 10-second trains of flashes were given for each frequency with intervals of at least seven seconds between stimulus trains. The eyes were open for the first five seconds of each train of flashes and closed for another five seconds. Generally the frequencies of one, two, four, six, 10, 12, 14, 16, 18, and 20 flashes/second and 60, 50, 40, 30, and 25 flashes/second were tried. PPR was defined in accordance with the subclassification of Waltz et

al.¹⁹ The responses were categorized into focal and generalized spikes. For each patient age, sex, family history of epilepsy, co-existence of other types of seizure, EEG findings, and neuroimaging findings were recorded. The seizures were categorized into different types according to classification and terminology of International League Against Epilepsy (ILAE) and the epileptic syndromes were classified according to the revised ILAE classification.^{20,21}

After the confirmation of diagnosis, treatments were started for the patients based on the neurologist's decision, and the results of treatment were recorded. Each patient was followed at least for two years after initiation of the treatment using serial EEGs with the standardized protocol of Kasteleijn-Nolst Trenité et al.¹⁸ EEG recording was done with an 18-channel bipolar and referential recording set according to the international 10 – 20 system.

Results

In our study, of 1705 patients with epilepsy attending the clinics, 30 (1.76%) patients under 12 years old were diagnosed as having TV epilepsy. Of them, 17 (56.7%) were females and 13 (43.3%) were males with a female to male ratio of 1.31:1. The mean age of the children at the time of diagnosis of seizure was 9.9 ± 2.1 (9.8 ± 2.1 in males, 9.9 ± 2.2 in females) with a range from six to 12 years.

Only one female patient had a positive family history of TV epilepsy (3.3% of all the patients). In addition eight patients (26.7%) had a family history of other kinds of epilepsy including seven females (41.2% of female patients and 23.3% of all) and one male patient (7.7% of male patients and 3.3% of all). Types of seizure of the patients are presented in Table 1.

Twenty-three patients (76.7%) showed generalized spikes on their EEG including 13 females (43.3%) and 10 males (33.3%), while only two males showed focal spikes (6.7%) and five patients (16.7%) had normal EEG findings without photic stimulation (interictal epileptiform discharges) including one male (3.3%) and four females (13.3%).

Twenty-seven patients (90%) showed generalized spikes on EEG in response to IPSs including 16 females (53.3%) and 11 males (36.7%). One female and two males (10%) had focal spikes in response to IPSs on their EEG recordings.

Table 1. Types of seizure among the studied patients.

Type of seizure	Male	Female	Total
Generalized tonic-clonic	12 (40%)	16 (53.3%)	28 (93.3%)
Absence	1(3.3%)	- (0%)	1 (3.3%)
Myoclonic	- (0%)	1 (3.3%)	1 (3.3%)
Pure TV epilepsy	7 (23.3%)	10 (33.3%)	17(56.7%)
TV epilepsy+other types of generalized seizure	6 (20%)	7 (23.3%)	13 (43.3%)

TV: television.

Twenty-nine patients had normal imaging findings (96.7%), and only one female patient (3.3%) showed generalized brain atrophy on magnetic resonance imaging (MRI).

Carbamazepine was prescribed for 17 (56.6%) patients while valproic acid was prescribed for 13 (43.3%) patients alone or in combination with the other drugs. All the patients were seizure free at most one year after initiation of treatments. Details of drug administration for these patients are shown in Table 2.

Discussion

In our study, TV epilepsy was more prevalent in females than males (1.31:1) and this is in line with previous studies on photosensitivity and TV epilepsy, which have reported a female preponderance of 1.69 to 1.^{7,22} However, there are some studies that have reported a male preponderance specially in video-game epilepsy.^{23,24} These differences in sex distribution maybe due to genotype and phenotype variability among different subgroups of visually-induced seizures or may be because boys play video games more than girls.

Previous studies showed that genetic transmission and positive family history played an important role in TV epilepsy.^{10,25,26} In our study, just 3.3% of the patients had a positive family history of TV epilepsy and 26.7% had a positive family history of any other kinds of epilepsy.

Previously it was thought that seizures induced by visual stimuli were almost exclusively

generalized,²⁷⁻²⁹ but there are studies that have discussed partial seizure as visual stimuli-induced seizure.^{30,31} Most of the patients in our study had generalized tonic-clonic seizure (43.3%), and absence and myoclonic were other types of seizure (each 3.3%). These findings are in line with previous studies that have reported the most common types of seizures are generalized tonic-clonic, followed by myoclonic and absence seizures.^{28,29}

The strong association of TV epilepsy with idiopathic generalized epilepsy has been reported in previous studies as well.³²⁻³⁴ In our study, 43.3% of the patients had associated epileptic syndromes all with generalized idiopathic epilepsy and 56.7% of the patients had pure TV epilepsy. This is in contrast to other reports, in which the frequency of pure TV epilepsy was reported less than epilepsy associated with other epileptic syndromes (26.1% vs. 73.9%).²⁹

In a recent study, interictal epileptiform discharges were reported in 83.6%, which were generalized in 74%.³⁴ In our study, 83.4% of the patients had interictal epileptiform discharges. Of them 76.7% had generalized spikes and 6.7% had focal spikes. In addition, 16.7% had normal EEG recordings without photic stimulation (interictal epileptiform discharges).

In previous studies, paroxysmal epileptiform discharges elicited by standard intermittent photic stimulation were reported in two-third of patients as generalized spikes and in the remaining as focal spikes.³⁴ In our study, 90% of the patients had generalized spikes and 10% had focal spikes in response to IPS on their EEGs and there were no normal EEG findings during IPS. It can be concluded that children with normal EEGs can be sensitive just to photic stimulations as previous studies had shown.³⁵⁻³⁷ It was interesting that children with normal EEG findings during interictal period without IPSs were those with pure TV epilepsy. Other studies had shown that 50% of patients had normal EEG recording without any photic stimulation.³⁷ But we found lower

Table 2. Anticonvulsant medications that were prescribed for the patients.

Anticonvulsant medication	Number of treated patients
Carbamazepine	13 (43.3%)
Valproic acid	7(23.3%)
Phenobarbital	2 (6.7%)
Carbamazepine+valproic acid	2 (6.7%)
Carbamazepine+phenobarbital	2 (6.7%)
Valproic acid+ethosuximide	1 (3.3%)
Valproic acid+lamotrigine	3 (10%)

frequencies and one may conclude that there is a significant correlation between abnormal EEG findings and TV epilepsy.

The choice for drug treatment depends on many factors such as the type of stimulus which triggers patient's seizures, the environment of patient's home and office, frequency and severity of seizures, and the type of epileptic syndrome.³⁸ Sodium valproate is suggested as first choice drug for children with TV epilepsy in many studies as monotherapy.^{22,38,39} Different studies have suggested many other drugs as second choices such as clobazam, carbamazepine, lamotrigine, topiramate, ethosuximide, and levetiracetam. But there is no consensus on them in different studies.³⁸ We used sodium valproate, lamotrigine, phenobarbital, carbamazepine, clonazepam, and ethosuximide alone or in combination with each other, and the response to treatment appeared to be beneficial in all cases. In our study, carbamazepine successfully prevented seizures in 43.3% of the patients with TV epilepsy.

The clinical and demographic differences of our patients compared with other reports are probably due to genetic differences. In our study, carbamazepine alone or in combination with other drugs has successfully terminated seizures in 56.6% of the patients. This demonstrates that carbamazepine can be used in children with TV epilepsy.

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