

The electroclinical-semiology of generalized tonic-clonic seizures among different epilepsies

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Abstract. – **OBJECTIVE:** The study reported here discusses the duration of the generalized tonic-clonic seizures (GTCS) among frontal lobe epilepsy (FLE), medial temporal lobe epilepsy (MTLE) and idiopathic generalized epilepsy (IGE).

PATIENTS AND METHODS: The study was done by analyzing the data from patients who had undergone video-EEG in 2009 and had GTCS during the monitoring. The patients were selected for the frontal lobe epilepsy (FLE), medial temporal lobe epilepsy (MTLE), and idiopathic generalized epilepsy (IGE). Once they met the criteria, the durations of all the phases were measured, then discussed if there were any difference in duration for different epilepsies.

RESULTS: On comparison of the total duration of various types of seizures it was found that the duration of FLE (177 ± 212.6 sec.) was significantly different from the duration of MTLE (104.6 ± 51.8 sec.) and IGE (63.9 ± 28.2 sec.). It can be found in the comparison of GTCS that the duration of phase 6,7 of FLE (63.5 ± 30.9 sec.) was statistically significant compared with MTLE (37.3 ± 13.8 sec.) and IGE (46.4 ± 30.1 sec.). The duration of various types of epilepsy in the generalized tonic-clonic period was not statistically significant.

CONCLUSIONS: Through this study, we found the differences of the duration of different types of epilepsies that provide the clinical basis for further studies of seizure mechanism and neural network conduction.

Key Words:

GTCS, Duration, Frontal lobe epilepsy, Medial temporal lobe epilepsy, Idiopathic generalized epilepsy.

Introduction

Generalized tonic-clonic seizures (GTCS) are the hallmarks of epilepsy for general public and brings many physiological and psychological burden to the patient's family. The epileptic

seizure is the important cause of sudden death in epileptic patients. As in this study, the onset of paroxysmal hypoxia is especially common in the GTCS attack, especially when the seizure is caused by the complex partial seizures and medication non-compliance among the patients¹. Sudden death occurs more in adults². The phase of the tonic phase is associated with the inhibition of the seizure in the seizure phase and indirectly related to the sudden death³. There are not many studies that have been documented on the clinical electrophysiological of GTCS.

There is only a small amount of the clinical research on the duration of the attack⁴. Through the intracranial electrodes, the complex partial seizures duration was studied. The duration of the complex partial seizures in the medial temporal lobe was longer than that of the temporal lobe neocortex⁵. On comparison with the scalp electrode for the duration of the attack it is concluded that partial seizure had the longest duration of the secondary synchronization⁶. The average duration through the video brain EEG was 52.9 sec. and 62 sec. respectively^{7,8}. After all, the studies it was observed that the duration of GTCS is not studied in details, and this study will discuss the differences of GTCS duration and staging of various types of epilepsy.

Patients and Methods

Patient Selection

This study reviewed all hospitalized patients with long range digital video EEG for 12 months between 2009.1.-2009.12 time period in Beijing Sanbo Brain Hospital. At least one time of GTCS seizure was required to record. Exclusion criteria: data lost, video data were not recorded, and patients with secondary status of epilepsy.

The Selection of Seizures

All the patients who met the requirements above and all the GTCS attacks were analyzed. Except: (1) A seizure which was less than 60 minutes from the previous attack; (2) The seizure which was terminated by drugs or there was any drug interventions during the attack.

Video-EEG Monitoring

Scalp electrodes were placed by the international 10-20 system and according to the illness need add temporal encryption electrode or sphenoidal electrode. Nicolet 64 or 128 lead (Madison, WI, USA) and infrared camera continuously recorded video EEG data for patients. All the patients had taken flash stimulation test and over ventilation test. Antiepileptic drugs were used to treat seizures in the preoperative evaluation of ictal EEG recording patients. However, patients with a continuous history of seizures, the frequency of attack and serious incidence were treated with caution on the issue of drug stops.

GTCS Attack Time Measurement

There is no unified staging of clinical symptoms in GTCS stage, and the symptoms analysis of GTCS is generally based on Gastauth and Broughton staging (Epileptic seizures: clinical and electrographic features, diagnosis and treatment. Springfield, IL: Charles C Thomas, Ed, 1972.). The GTCS is divided into four periods, pre attack, attack, early after the onset and late after the onset by the authors. This study combined with Gastauth (1972) and Theodore et al⁷ stage, only discussed early attack and attack. And divided them into 7 stages (Table I).

First phase: As simply partial seizures (SPS), the focal seizures and consciousness retention were characterized. Whether to retain consciousness is a difficult problem, technicians were needed to detect that at time. In the

study, we identified the technician to detect the retention of consciousness; they could speak at the onset of the outbreak, or could recall the aura after the attack to determine.

Second phase: This period includes three types of seizures: complex partial seizures (CPS), clonic seizures, and tonic seizures. Need to emphasize here clonic seizures and tonic seizure is often classified as full seizures. The characteristic of clonic seizures is rapid bilateral clonus. The tonic seizure features a sudden increase in muscle tone, often asymmetric, sometimes involving the axial muscle.

Third phase: The onset of the full attack, generally head deflection attack, physical activity or sound as a feature.

Fourth phase: Clonic phase before the tonic-clonic. The performance is the body and the facial transient, irregular tic, also known as the early attack paramyoclonus.

Fifth phase: tonic phase. Sustained muscular contraction.

Phases 6-7: The clonic phase from the tonic gradually transited, began to be quiver 8Hz, gradually slowing down to 4Hz, tetanic muscle contracted and repeated tension disappeared coexist to form a continuous flexion spasm and later slowed to 1Hz.

The first phase and the 2nd phase are defined as pre attack. Phases 3-7 are defined as GTCS attack stage.

Attack Symptom Analysis

It was analyzed by two independent EEG analysts, by blind method, that means that analyst had no related history data or diagnosis of patients. Each stage of symptoms has a strict definition of the concept, and requires the operator to repeatedly measure the average number 3 times. Analysts needed to measure the duration for each stage and calculate the total duration of GTCS.

Table I.

Pre attack		GTCS attack stage				
Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7
Simple partial seizures	Complex partial seizures/clonic seizures/tonic seizures	Generalized attack initiation	Clonic before the tonic	Tonic phase	Quiver	Clonus

Table II. Total duration of seizures.

Epileptic grouping	Patients	Average duration of seizures (sec)	Standard deviation
MTLE	13	104.6	51.8
FLE	8	177.0	212.6
IGE	10	63.9	28.2

Diagnosis Standard of Medial Temporal Lobe Epilepsy (MTLE), Frontal Lobe Epilepsy (FLE) and Idiopathic General Epilepsy (IGE)

The patients in the group were in line with the standard above and add the following criteria. Requirements of standard MTLE grouping: patients whose lesions were restricted in the medial temporal lobe, after the evaluation system of epilepsy surgery and the resection of the temporal lobe structures, follow-up more than one year, prognosis grading as Engle class I.

Frontal lobe epilepsy: patients whose lesions were confined to the frontal lobe, after the evaluation system of epilepsy surgery and the resection of the temporal lobe structures, follow-up for more than 6 months, prognosis grading as Engle class I.

Idiopathic general epilepsy: According to the definition of idiopathic epilepsy ILAE proposed in 2001, it is required that a syndrome has only epilepsy without potential structural brain lesions or other neurological symptoms and signs, may be related to the potential gene, often age-related⁹. This research required the generalized epilepsy patients, whose ictal and interictal were all discharge, cognitive function of patients were normal, nervous system tests were normal without obviously abnormal imaging.

Statistical Analysis

Data management and statistics were used by Excel and SPSS 22 (SPSS Inc., Chicago, IL, USA). One-way ANOVA was used and the com-

parison between the groups was used by LSD-*t*-test. $p < 0.05$ indicated the statistically significance.

After statistical analysis, we found that through the variance analysis, the difference of onset duration of various types of epilepsy had statistical significance ($F = 3.28$ $p = 0.047$) after each pair wise comparison among the groups, we found that FLE and IGE were statistically different ($p = 0.015$), while FLE and MTLE, IGE and MTLE had no statistical difference (Table II). The difference of the duration of phase 6, 7 was statistically significant ($F = 4.6$ $p < 0.05$), after the pair wise comparison among each group, it was found that MTLE and FLE had statistically significant difference ($p < 0.05$), FLE and MTLE, IGE and MTLE had no statistical difference (Table IV).

By using the analysis of variance for the duration of three types of epilepsy of the rest of the phases, there was no statistical significance, duration of GTCS ($F = 2.94$, $p > 0.05$) (Table III) duration of the first phase ($F = 1.64$, $p > 0.05$) duration of the second phase ($F = 2.21$, $p > 0.05$) duration of the third period ($F = 0.488$, $p > 0.05$) duration of the four phase ($F = 1.037$, $p > 0.05$) duration of the five phase ($F = 1.32$, $p > 0.05$) there was no statistically significant difference among FLE, MTLE and IGE.

Results

Attack Analysis

Because of the heterogeneity of multiple episodes of the same patient, this study mainly discusses each attack. During the 12-month study

Table III. Duration of GTCS attack.

Epileptic grouping	Patients	Average duration of seizures (sec)	Standard deviation
MTLE	13	61.1	24.0
FLE	8	82.0	27.6
IGE	10	61.3	27.6

Table IV. Duration of each phase of the seizures.

Phase	Epileptic types	Average duration (sec)	Standard deviation
Phase 1	MTLE	14.86	37.2
	FLE	2.92	5.6
	IGE	0.7	1.8
Phase 2	MTLE	29.9	23.4
	FLE	90.7	214.9
	IGE	2.2	3.8
Phase 3	MTLE	6.3	10.7
	FLE	8.9	7.8
	IGE	5.6	8.2
Phase 4	MTLE	3.3	6.8
	FLE	1.3	2.7
	IGE	1.2	2.5
Phase 5	MTLE	12.0	8.8
	FLE	8.3	8.0
	IGE	8.1	6.9
Phase 6, 7	MTLE	37.3	13.5
	FLE	63.5	30.9
	IGE	46.4	30.1

period between January 2009 and December 2009, the epilepsy center recorded 310 GTCS attacks, of which two failed to complete records because patients left the camera monitoring range. There were 3 secondary status epilepticus, for 30 attacks due to the emergence of a concentrated attack. Each attack interval time was less than 1 hour and drug intervention was used during the attack, but between each attack consciousness could be recovered. So this paper will discuss 275 attacks of 153 patients.

Preoperative location was the temporal lobe, 19 patients had excision of temporal lobe (medial), 4 patients had excision of temporal lobe (lateral), of which 13 cases of Engel⁹ grade I (containing 21 GTCS total seizures). Preoperative location was the frontal lobe, and there were 10 cases of frontal resection, of which 8 cases were Engel I. Idiopathic generalized epilepsy was in 10 cases.

In this study, of 153 patients, the patients with medial temporal lobe epilepsy, frontal lobe epilepsy, and idiopathic generalized epilepsy were analyzed. There were a total of 13 patients in line with the standard of medial temporal lobe epilepsy (MTLE) group with 21 attacks, eight patients in line with the standard of frontal lobe epilepsy (FLE) group with 13 attacks, 10 patients in line with the standard of IGE group with 14 attacks. Analyze the total duration of seizures (Phases 1-7), duration of GTCS (Phases 3-7) and duration of each phase of the seizures.

Conclusions

The duration of seizure was divided into seven periods, including primary generalized tonic-clonic seizure and secondary generalized tonic-clonic seizures. The durations of each period were calculated so as to see whether the differences of frontal lobe epilepsy, temporal lobe epilepsy and idiopathic comprehensive epilepsy duration have statistical significance.

The study found that the GTCS durations of all types of epilepsy were similar. The GTCS duration of temporal lobe epilepsy was 82.0 ± 27.6 sec., the GTCS duration of the medial temporal lobe epilepsy was 61.1 ± 24.0 sec., the GTCS duration of idiopathic generalized epilepsy 61.3 ± 27.6 sec. and $p > 0.05$ indicated no significant differences. Jenssen et al⁵ found that the GTCS duration of the secondary CPS was 74.0 seconds, but Theodore et al⁷ studies of 47 hospitalized patients confirmed that the duration was 67 seconds, while Kramer et al⁸ initially studied the SGTCs duration of 23 patients as 52.9 seconds. All of these studies are based on video EEG. Thus, the GTCS durations are basically similar. In addition, there is the research on the onset time, but it is based on the memory of the witness, research has shown that first attack of children often lasts 10 minutes and often more than 30 minutes, compared to these video EEG studies, maybe because of witness personal factors, but whether the first attack will last a longer time needs further research¹⁰.

In the comparison of the total duration of various types of seizures, it was found that the duration of frontal lobe epilepsy (177 ± 212.6) had a significant difference compared with medial temporal lobe epilepsy (104.6 ± 51.8) and idiopathic generalized epilepsy (63.9 ± 28.2). In the comparison of GTCS of different phases, it can be found that for the duration of phase 6,7, FLE (63.5 ± 30.9) had statistically significant difference compared with MTLE (37.3 ± 13.8) and IGE (46.4 ± 30.1). Basic research of different mechanism of the duration of different types of epilepsy is less, Lado et al¹¹ summarized the possible mechanism, from neuronal cells to neurons and the connection with glial and even to nuclei such as the substantia nigra reticular (SNR) formation, all have related mechanism.

The inclusion criteria for patients with frontal lobe epilepsy and medial temporal lobe epilepsy is strict, including follow-up for more than one year, prognosis stage of Engle grade I, which also required that patients with idiopathic generalized epilepsy should be with normal cognitive function, nervous system detection and imaging findings in the stage of attack and interval with epilepsy. All these criteria will result in a small number of cases and attacks included. So more data will be needed for further research. Some of attacks in this study were under the condition of the adjustment of drugs and sleep deprivation, and it may have some differences with the attack duration of natural attack in this case.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

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