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CLINICAL RESEAPCH

Effect of Epileptiform Discharge Index on Cognitive Impairment in Adult Epilepsy Patients under Different Conditions

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Keywords

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Abstract

Objective The study explored the effect of epileptiform discharge index (IED) on cognitive impairment in adult epilepsy patients under different conditions. **Methods** A total of 50 epilepsy patients treated in our hospital from Jun. 2019 to Dec. 2020 were selected as observation group, and 50 healthy persons in the same period were selected as control group. The time of sleep in Ⅰ-Ⅱ stages, time of sleep in Ⅲ-Ⅳ stages, total sleep time, number of arousal and frequency of sleep phase transition in two groups were compared. IED in patients with epilepsy in waking and sleeping stages were measured and its relationship with Wechsler Intelligence Scale (WAIS-RC) and Wechsler Memory Scale (WMS-RC) scores were analyzed. **Results** The time of sleep in Ⅰ-Ⅱ stages of observation group was longer than that of control group. The time of sleep in Ⅲ-Ⅳ stages of observation group was significantly shorter than that of control group. The number of arousal and frequency of sleep phase transition in observation group were significantly higher than those in control group. WAIS-RCIQ and WMS-RCMQ of epilepsy patients in sleeping stage with 10%<IED<50% were significantly lower than those with 0%<IED<1% and 1%<IED<10%. WAIS-RCIQ and WMS-RCMQ of the patients in sleeping stage with IED>50% were significantly lower than those with 0%<IED<1% and 1%<IED<10%. WAIS-RCIQ and WMS-RCMQ of epilepsy patients in waking stage with 10%<IED<50% were significantly lower than those with 0%<IED<1% and 1%<IED<10%. WAIS-RCIQ and WMS-RCMQ of the patients in waking stage with IED>50% were significantly lower than those with 0%<IED≤1% and 1%<IED≤10%. During waking and sleeping stages, there was significant difference of WAIS-RCIQ and WMS-RCMQ among the four groups (0%<IED<1%, 1%<IED<10%, 10%<IED<50%, IED>50%). **Conclusion** Epileptiform discharges could reduce sleep quality and severely affect cognitive function of patients, and 10% might be the lowest threshold of epileptiform discharge affecting cognitive function of patients.

Introduction

Epilepsy is a recurrent and complex nervous system disease caused by imbalance of excitation and inhibition in the brain. The research shows that patients with epilepsy are usually accompanied by symptoms such as sleep disorder and cognition hypofunction. Cognitive impairment is a common concomitant symptom of patients with epilepsy, the frequent manifestations of which comprise decrease of attention to general knowledge and ability decline of perception of things, abstract generalization, planning, judgment, reading and learning. Cognitive impairment badly influences the quality of life of patients with epilepsy and also brings heavy burden to society and families. Multiple factors result in cognitive impairment of epilepsy patients, among which epileptiform discharge is a pivotal element. Nevertheless, currently the specific mechanism of epileptiform discharge on cognitive impairment in clinic is unclear. The present work analyzed the relationship of epileptiform discharge index (IED) on cognitive impairment of adult epilepsy patients under different conditions, trying to provide the proof for clinical treatment.

Materials and methods

Clinical data

A total of 50 epilepsy patients treated in our hospital from Jun. 2019 to Dec. 2020 were selected as observation group, and 50 healthy persons in the same period were selected as control group. Observation group: gender, 23 males and 27 females; average age, 33.48 ± 6.24; average course of disease, 9.31 ± 2.24. Control group: gender, 21 males and 29 females; average age, 32.75 ± 6.57. Gender and age of patients were comparable by statistical analysis ($P>0.05$). Inclusion criteria were: patients met the diagnostic criteria of epilepsy with good compliance and epileptiform discharge was detected in recent electroencephalogram examination. Exclusion criteria were: patient had a malignant epilepsy syndrome affecting cognitive function, the seizure type of which was transient non-convulsive attack. The work was approved by the Ethics Committee of in our Hospital and the informed consent was acquired from all patients.

Method

1. The 24-hour examination with digital video electroencephalograph was made to patients of both groups in physiological state. 2. Epileptiform discharge of patients in waking and sleeping stages was detected through video electroencephalogram.

Outcome measures

1. The time of sleep in Ⅰ-Ⅱ stages, time of sleep in Ⅲ-Ⅳ stages, total sleep time, number of arousal and frequency of sleep phase transition were tested by video electroencephalogram. 2. IED of patients with epilepsy in waking and sleeping stages was assessed using video electroencephalogram and its relationship with Wechsler Adult intelligence scale-Revised in China (WAIS-RC) and Wechsler Memory Scale-Revised in China (WMS-RC) scores was assessed. IED was divided into four grades: $0\%<IED\leq1\%$, $1\%<IED\leq10\%$, $10\%<IED\leq50\%$ and $IED>50\%$. WAIS-RC contained 11 items: information, comprehension, arithmetic, similarities, digit span, vocabulary, digit symbol, picture completion, block design, picture arrangement and object assembly. The language score was composed of the first six items while the other five items formed work score, with the total score 145. As for WMS-RC, long-term memory included personal experience, time and space (orientation) as well as numerical order; short-term included visual recognition, pictures recall, visual reproduction, association study, touch test and comprehension memory; immediate memory included the number of digits forward and digits backward; the total score of WMS-RC was 100. The lower scores of WAIS-RC and WMS-RC indicated the more serious cognitive impairment.

Statistical analysis

Statistical analysis was made through SPSS 22.0 (IBM, Armonk, NY, USA). The enumeration data were compared by the χ^2 test and the measurement data were presented as the means ± standard deviation

with ANOVA utilized for contrast. A statistically significant difference was accepted when $P<0.05$.

Results

Characteristics of video electroencephalogram during sleep

Observation group appreciably increased the time of sleep in Ⅰ-Ⅱ stages whereas decreased the time of sleep in Ⅲ-Ⅳ stages in comparison with control group (Table 1, $P<0.05$). The total sleep time did not differ obviously between observation group and control group (Table 1, $P>0.05$). The number of arousal and frequency of sleep phase transition in observation group were notably higher than those of control group (Table 1, $P<0.05$).

Table 1 Characteristics of video electroencephalogram during sleep between two group

Group	Case	Time of sleep in Ⅰ-Ⅱ stages (h)	Time of sleep in Ⅲ-Ⅳ stages (h)	Total sleep time (h)	Number of arousal (time)	Frequency of sleep phase transition (time/h)
Observation	50	4.96±0.57	0.82±0.21	5.72±0.45	12.14±2.78	123.66±14.15
Control	50	3.54±0.36	2.38±0.32	5.77±0.42	7.86±1.53	51.48±9.37
t		14.894	-28.820	-0.574	9.537	30.074
P		0.000	0.000	0.567	0.000	0.000

IED of adult patients with epilepsy in sleeping stage and its relationship with cognitive impairment

A total of 34 cases with epileptiform discharge in sleeping stage were identified in observation group, in which WAIS-RC Intelligence Quotient (WAIS-RCIQ) and WMS-RC Memory Quotient (WMS-RCMQ) of patients with 10%<IED≤50% were both lower than those of patients with 0%<IED≤1% and 1%<IED≤10% (Table 2, $P<0.05$). Patients with IED>50% dramatically declined WAIS-RCIQ and WMS-RCMQ relative to 0%<IED≤1% and 1%<IED≤10% (Table 2, $P<0.05$). And there existed significant difference of WAIS-RCIQ and WMS-RCMQ among groups of 0%<IED≤1%, 1%<IED≤10%, 10%<IED≤50% and IED>50% (Table 2, $P<0.05$).

Table 2 IED of adult patients with epilepsy in sleeping stage and its relationship with cognitive impairment

IED	Case	WAIS-RCIQ (point)	WMS-RCMQ (point)
0%<IED≤1%	2	82.16±8.37	86.36±8.41
1%<IED≤10%	20	85.54±9.45	81.41±8.32
10%<IED≤50%	10	74.21±7.31[ab]	74.62±7.45[ab]
IED>50%	2	72.15±6.85[ab]	67.88±6.27[ab]
F		4.493	3.446
P		0.010	0.029

Note: compared with 0%<IED≤1%, [a]$P<0.05$; compared with 1%<IED≤10%, [b]$P<0.05$.

IED of patients with epilepsy in waking stage and its relationship with cognitive impairment

In total, 26 cases with epileptiform discharge in waking stage were identified in observation group, in

which WAIS-RCIQ and WMS-RCMQ of patients with 10%<IED≤50% notably reduced when contrasted with those of patients with 0%<IED≤1% and 1%<IED≤10% (Table 3, P<0.05). Besides, WAIS-RCIQ and WMS-RCMQ of patients with IED>50% were lower than those of patients with 0%<IED≤1% and 1%<IED≤10% (Table 3, P<0.05). And there was significant difference of WAIS-RCIQ and WMS-RCMQ among groups of 0%<IED≤1%, 1%<IED≤10%, 10%<IED≤50% and IED>50% (Table 3, P<0.05).

Table 3 IED of patients with epilepsy in waking stage and its relationship with cognitive impairment

IED	Case	WAIS-RCIQ (point)	WMS-RCMQ (point)
0%<IED≤1%	3	83.36±7.25	83.14±8.36
1%<IED≤10%	13	87.65±8.63	86.65±8.75
10%<IED≤50%	8	69.65±6.32[ab]	70.12±7.23[ab]
IED>50%	2	72.54±6.59[ab]	67.66±6.88[ab]
F		9.751	8.409
P		0.000	0.001

Note: compared with 0%<IED≤1%, [a]P<0.05; compared with 1%<IED≤10%, [b]P<0.05.

Discussion

Epilepsy is a recurrent and chronic nervous system disease resulting from abnormal discharge of highly assimilated brain neurons, which badly damages human health. Clinically, epileptiform discharge of epilepsy patients can be detected through electroencephalograph and will bring about injury on different degree to function and structure of brain neurons. Thus, epilepsy will probably damage sleep quality and cognitive function of patients. It has been reported that the overall intelligence level of patients with epilepsy was lower than normal people and it was mainly because the individual factor underlying cognitive function was affected, which seriously influenced quality of life of patients. Hence, it is an important task to treat epilepsy and ameliorate sleep quality as well as cognitive function of patients in clinic.

Epileptiform discharge will badly affect sleep quality of patients, leading to daytime sleepiness, weakness and memory loss. In the meanwhile, the poor sleep quality increases the frequency of epileptiform discharge in turn and deteriorates epilepsy even further. Our research found that observation group appreciably increased the time of sleep in Ⅰ-Ⅱ stages whereas decreased the time of sleep in Ⅲ-Ⅳ stages in comparison with control group, and the number of arousal and frequency of sleep phase transition in observation group were notably higher than those of control group, suggesting that sleep quality of patients with epilepsy was worse than healthy persons. The previous work exhibited that epileptiform discharge had a significant correlation with sleep, which enabled the sleep structure of epilepsy aptients to be different from normal people to impact on quality of sleep. Thereby, the effective targeted suppression of epileptiform discharge could improve sleep quality of patients with epilepsy.

Epileptiform discharge plays a critical role in cognitive function. And a former research presented that the cognition hypofunction of epilepsy patients was not caused by epileptic seizure, but associated with frequent IED which may influenced cognitive function through interference of normal neural network structure. The present work investigated the relationship between IED of epilepsy patients in sleeping and waking stages and cognitive impairment and it was viewed that WAIS-RCIQ and WMS-RCMQ of epilepsy patients in sleeping and waking with 10%<IED≤50% and IED>50% were

lower than those of patients with 0%<IED≤1% and 1%<IED≤10%. Those data implicated that 10% might be the lowest threshold of epileptiform discharge affecting cognitive function of patients and epilepsy patients would performed cognitive impairment when epileptiform discharge was over 10%. The reason why epileptiform discharge resulted in cognitive impairment is mainly because epilepform discharge interfered information transfer of normal neurons, changed normal synaptic connections and neural circuits to induce cerebral ischemia and anoxia with secondary oxidative stress injury and cause apoptosis and necrosis of hippocampal neurons, the loss of which induced mossy fiber sprouting and reorganization of excitatory neural circuits so as to bring about cognitive impairment.

In summary, epileptiform discharges could reduce sleep quality and led to cognitive impairment, which did great harm to life of patients. And 10% might be the lowest threshold of epileptiform discharge affecting cognitive function of patients.

Declaration of conflict-of-interest:

The authors declare no conflict-of –interest.

References

[1] Soler RM,Denays R,Sinzobahamvya E. Abdominal epilepsia partialis continua due to cortical ischemia: a video-documented case report and review.[J].ACTA NEUROL BELG,2020,26(1):22-24.

[2] Fernández TJ,Lucas EM,Urdiales SS,et al. Lingual epilepsia partialis continua: a detailed video-EEG and neuroimaging study.[J].EPILEPTIC DISORD,2020,22(4):461-465.

[3] Espinosa JC.Cannabinoides en epilepsia: eficacia clínica aspectos farmacológicos[J]. NENROLOGIA,2020,18(33):62-66.

[4] Tsubouchi Y,Tanabe A,Saito Y,et al. Long-term prognosis of epilepsy in patients with cerebral palsy.[J]. DEV MED CHILD NEUROL,2019,61(9):1067-1073.

[5] Pedro, Paulo, Gomes, et al. Interictal dysphoric disorder: a frequent psychiatric comorbidity among patients with epilepsy who were followed in two tertiary centers.[J]. ARQ NEURO-PSIQUIAT, 2013,71(11):852-855.

[6] Martorell LC,González LP,Luna E,et al.Resultados clínicos e impacto en la calidad de vida[J]. NENROLOGIA,2019,22(7):1-9.

[7] Mbizvo GK,Lentell IC,Leen C,et al. Epilepsia partialis continua complicated by disseminated tuberculosis and hemophagocytic lymphohistiocytosis: a case report.[J]. INT MED CASE REP J,2019,13(1):191.

[8] Leslie R,Beata J,Rochelle Z,et al Tcheng,Thomas C. Neylan,Vikram R. Rao. Sleep disruption is not observed with brain‐responsive neurostimulation for epilepsy[J]. Epilepsia Open,2020,5(2):155-165.

[9] Allison RM,Paul CT,Paul WS,et al. Obstructive sleep apnea in refractory epilepsy: A pilot study investigating frequency, clinical features, and association with risk of sudden unexpected death in epilepsy[J]. Epilepsia,2018,59(10):1973-1981.

[10] Zuo CW,Jun ZZ,Jian Z,et al. Automatic recognition of epileptic discharges based on shape similarity in time-domain[J]. BIOMED SIGNAL PROCES,2017,15(12):33.

[11] Lifang D,Changhong D,Fang F. Two Chinese siblings with two novel KCTD7 mutations have dystonia or seizures and epileptic discharge on electroencephalograms[J]. SEIZUREe,2019,70(33):584-589.