

Original Article

Long-term therapeutic effects of corticoamygdalohippocampectomy for bilateral mesial temporal lobe epilepsy

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Abstract

Background: Some cases of paradoxical mesial temporal lobe epilepsy (MTLE) are shown to be bilateral MTLE (BMTLE) by intracranial electrodes. The treatment for BMTLE is difficult, which poses several questions. Can corticoamygdalohippocampectomy (CAH) be applied to treat BMTLE? What are the long-term therapeutic effects if CAH is performed in BMTLE patients?

Methods: Four patients were shown to have BMTLE through bilateral intracranial electrode implantation. CAH was performed on the side with relatively more seizure originations. These patients were followed-up at 6 months, 1 year, 2 years and longer, in some cases, after the CAH. The postoperative seizure frequency was recorded. Preoperative and postoperative clinical memory tests and a postoperative 4-hour video electroencephalography (EEG) were conducted in the hospital at different follow-up times. The average seizure frequencies and memory quotient scores were analyzed.

Results: The average seizure frequency significantly decreased by 80.8%, 83.5%, and 84.3% at different postoperative times. Although no patient was seizure free, the intensity of the seizures was reduced in all cases. The postoperative average memory quotient score was moderately decreased by 15.8%, 11.7%, and 16.6% at different postoperative times. Both the average values of the postoperative seizure frequency (5.5, 4.75, and 4.5 per month) and the average values of the postoperative memory quotient (73.7, 77.3, and 73) at different postoperative times were approximately the same.

Conclusions: CAH reduced the seizure frequency and intensity in these BMTLE patients. Mild hypomnesia occurred in every case. We observed the long-term treatment effects at 6 months after the CAH and showed that the effects did not change at that time or over the next few years.

Key Words: Mesial temporal lobe epilepsy, corticoamygdalohippocampectomy, long-term therapeutic effect, memory

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INTRODUCTION

Mesial temporal lobe epilepsy (MTLE) is a common

epilepsy type and is usually resistant to antiepileptic drugs. Typical unilateral MTLE is associated with good outcomes after corticoamygdalohippocampectomy (CAH).^[5,8,9]

However, it is difficult to lateralize paradoxical MTLE through noninvasive methods (paradoxical in semiology, electroencephalography (EEG), imaging and positron emission tomography and computerized tomography (PET-CT)). Bilateral intracranial electrode implantation is necessary for paradoxical MTLE. Some paradoxical MTLE cases were shown to be unilateral MTLE, while some were shown to be bilateral MTLE (BMTLE). In BMTLE, seizures originate independently from the left and right mesial temporal lobes. There are few reports in the literature about the treatment of BMTLE,^[1] and the popular opinion is that CAH should be avoided after BMTLE is diagnosed. Bilateral hippocampus electric stimulation might be effective for BMTLE.^[13] In China, decisions about how to treat BMTLE patients can occasionally be challenging. Patients and their families spend a great deal of time and money on the surgery to implant the intracranial electrodes, and most patients cannot afford bilateral hippocampus electric stimulation. These challenges raise several questions. Can CAH be used for BMTLE patients? What will occur if we perform CAH for BMTLE patients on the side with relatively more seizures? We considered four BMTLE patients who underwent CAH from July 2006 to July 2011. We followed these patients for at least 2 years to determine their seizure frequency and memory quotient. We report these cases here.

MATERIALS AND METHODS

Patients

Four cases, including three males and one female (aged 19, 22, 32, and 53 years), were studied. The duration of their medical histories was 9, 12, 15, and 33 years, and the number of antiepileptic drugs used before intracranial electrode implantation was 2, 3, 3, and 2. Every patient was diagnosed as having refractory paradoxical MTLE. The neurological function examinations (cranial nerve, motor and sensory nerve, coordination movement, and gait) were normal for these four cases.

Preoperative evaluation and CAH

The duration of the medical history was greater than 2 years and the seizure frequency was greater than 12 times per year in every case. The four cases had typical symptoms of MTLE at the beginning of the seizures, such as oral and limb automatism. The preoperative noninvasive examination included a head magnetic resonance imaging (MRI) (including a coronal flair sequence), ictal EEG (at least three times habitual seizures) and brain PET-CT.

From July 2006 to July 2011, we examined 37 patients with refractory paradoxical MTLE. Lateralization was difficult to determine using noninvasive examinations and semiology. These 37 cases underwent bilateral intracranial electrode implantation through key-holes in

the bilateral temporal areas. Five cases were shown to be BMTLE through ictal intracranial EEG. Of these, four cases underwent CAH on the side with more seizures according to the intracranial EEG results, and one case did not undergo CAH due to the same frequency of seizures on both sides. Four cases had typical temporal automatism. The head MRI showed asymmetric hippocampal structural abnormalities in these four cases, and their brain PET-CT results showed asymmetric metabolism decreases in both temporal lobes.

Surgical techniques

The four patients underwent bilateral temporal intracranial electrode implantation. Intracranial electrodes were implanted through key-holes (bone hole diameter of 1.5 cm, scalp incision of 5 cm) in the bilateral middle temporal areas. Four channel deep intracranial electrodes pointing to the hippocampus and amygdala were implanted using stereotactic techniques. Four channel strip electrodes were implanted to the anterior temporal, middle temporal, subtemporal, and posterior temporal areas. The CAH involved resections of the anterior temporal lobe (≤ 4.5 cm on the predominant side, ≤ 5 cm on the nonpredominant side), hippocampus, and amygdala.

Follow-up

The four patients were asked to come to the hospital at 6 months, 1 year, and 2 years after the CAH, and the postoperative seizure frequency was recorded at these time points. Some patients were followed even longer by telephone. The clinical memory test and postoperative 4-hour video EEG were conducted at 6 months, 1 year, and 2 years. The clinical memory test used the clinical memory scale (Chinese version, simplified and revised Wechsler memory scale), which has been frequently used in psychiatry and psychology in China. The memory quotient assessment used the score from the clinical memory test (corrected for age and intelligence). The preoperative intelligence test and clinical memory test were conducted in all paradoxical MTLE patients.

RESULTS

The clinical seizure times, side of origination in the intracranial EEG, seizure frequency, and memory quotients are shown in Table 1. The average seizure frequency significantly decreased by 80.8%, 83.5%, and 84.3% at 6 months, 1 year, and 2 years, respectively, but no patient was seizure-free postoperatively. However, the intensity of the seizures was relieved in all cases. The postoperative average memory quotient score decreased slightly by 15.8%, 11.7%, and 16.6% at 6 months, 1 year, and 2 years, respectively. Both the average frequency of postoperative seizures (5.5, 4.75, and 4.5 per month) and the average values of the postoperative memory

quotient (73.7, 77.3, and 73) at the different postoperative times were approximately the same. The preoperative and postoperative EEG findings are shown in Table 2. There were no neurological functional deficits in the four cases after the CAH.

DISCUSSION

This exploration of the surgical results after CAH to treat BMTLE patients is a pioneer study and has clinical importance. Paradoxical MTLE is usually shown to be unilateral MTLE through bilateral intracranial electrode implantation.^[4,7] Occasionally, some patients are shown to have BMTLE,^[10,12] and treatment options must be considered. CAH cancellation has been considered unacceptable by patients or their relatives due to the large expense associated with intracranial electrode implantation in China. The decisions regarding treatment raise several questions. Can CAH be performed on the side with more seizures? If we perform CAH on the side with more seizures, what will occur? Does CAH reduce seizure frequency? Are there any neuropsychological complications? This study explored and partially answered these questions.

We had too few patients (4 cases) to analyze the data using statistical methods. We only analyzed the

percentage change in the average values of the seizure frequency and memory quotient. Although some data were lost [Table 1], the four cases were followed for 2 years or longer.

Based on the results of this study, we demonstrated that CAH reduced the seizure frequency of the patients at different follow-up times and that CAH did not lead to neurological function deficits. Although no patient was seizure-free, the CAH had long-term therapeutic effects in seizure control for all of these BMTLE patients. The postoperative seizure frequency at the different follow-up times was approximately the same, which indicated that we could observe the treatment effect at 6 months after CAH and that the effect would not change over time (up to 5 years after the procedure, in some cases).

The seizure intensity was reduced after CAH in every patient. However, the reason for this change was unknown but may be related to a disruption of the possible synergetic enhancement in MBTLE seizures.

Although the CAH had good effects with respect to decreasing the postoperative seizure frequency and improving the ictal intensity relief for these BMTLE patients, this procedure also caused mild memory function damage over a long-term period.

Table 1: Intracranial EEG and postoperative therapeutic effects of 4 bilateral mesial temporal lobe epilepsy patients

Cases	Origination side and ictus times		Monthly number of ictus and memory quotient scores at different postoperative times											
	Left	Right	Preoperative		6 months postoperative		1 year postoperative		2 years postoperative		3 years postoperative		5 years postoperative	
			SF	MQ	SF	MQ	SF	MQ	SF	MQ	SF	MQ	SF	MQ
1	3	1	10	92	4	80	2	84	3*					
2	2	4	60	78	10	66	6*		7	70	6		6*	
3	7	3	15	91	3*		5	76	4	75				
4	1	8	30	89	5	75	6	72	4	74	4*		5*	

SF: Seizure frequency, MQ: Memory quotient. The postoperative follow-up time did not occur strictly at 6 months, 1 year, or 2 years. Some patients were assessed 1-2 months before or after those time points. Blank items indicate that the patient did not come to the hospital at that time.* indicates that the value was obtained through telephone follow-up. Seizure frequency indicates the monthly average frequency (integer) of clinical seizures (not subclinical seizures) during the most recent half year

Table 2: EEG findings at different times

Cases	Preoperative discharge areas and ictal origination			Postoperative interictal discharge areas	
	Scalp interictal	Scalp ictal	Intracranial ictal	6 months	1 and 2 years
1, Left CAH	Bilateral SP, AT, MT, PT (left more than right)	Left AT, MT (3 seizures) Right SP, AT (1 seizure)	Left HI (3 seizures) Right HI (1 seizure)	Left MT, PT Right: SP, AT, MT, PT	Almost same as that of 6 months
2, Right CAH	Bilateral SP (right more than left)	Right SP (4 seizure) Left AT (1 seizure)	Right HI (4 seizures) Left HI (2 seizures)	Right MT, PT Left: SP	Almost same as that of 6 months
3, Left CAH	Bilateral SP, AT, MT (left more than right)	Left SP, AT, MT (2 seizures) Right SP (1 seizure)	Left HI (7 seizures) Right AM (3 seizures)	Left MT, PT Right SP, AT, MT	Almost same as that of 6 months
4, Right CAH	Bilateral SP, AT (right more than left)	Right SP (3 seizure) Left AT (2 seizures)	Right HI (8 seizures) Left HI (1 seizure)	Right MT, PT Left SP, AT	Almost same as that of 6 months

HI: Hippocampus, AM: Amygdala, SP: Sphenoid electrodes, AT: Anterior temporal, MT: Middle temporal, PT: Posterior temporal. The preoperative scalp and intracranial EEG were long-term video EEGs that included several clinical seizures. The postoperative EEG was 4 hours of video EEG

The postoperative average memory quotients at different times were lower than the preoperative values. The average values of the postoperative memory quotient (73.7, 77.3, and 73) at different postoperative times were approximately the same, which indicated that we could determine the memory function damage at 6 months after CAH and that the damage would not change over time. Because the temporal lobe and hippocampus are responsible for memory function,^[3,6,14] it is easy to understand that unilateral CAH can result in memory function damage. The memory quotient does not represent all neuropsychological changes, and there might be other changes that occur after CAH for BMTLE patients. Memory function damage is the most common complication after CAH in unilateral MTLE;^[2,11] because the memory quotient is relatively easy to examine and qualitatively analyze, we chose this index to assess the neuropsychological changes after CAH for these BMTLE patients.

The preoperative interictal EEGs showed bilateral sphenoid electrodes and anterior middle and posterior temporal area discharges in every case. Moreover, the ictal discharges and intracranial EEGs showed a bilateral origination. The postoperative EEGs showed that operation contralateral interictal discharges were approximately the same as the preoperative discharges in every case and that there were epileptic discharges from the middle and posterior temporal areas on the side of the operation. The postoperative EEG findings did not change over time.

CONCLUSION

There is no doubt that CAH can reduce seizure frequency and relieve seizure intensity for BMTLE patients. However, no patient in this study was seizure-free, and every case experienced mild hypomnesia. CAH on the side in which more seizures originate for BMTLE should be very cautiously performed and is not universally recommended. If the seizure frequency has no side predominance and the patient cares strongly about memory function, we do not recommend CAH. Rather, bilateral hippocampus electric stimulation should be recommended for these patients.^[8]

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