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Zygomatic Osteotomy for Resection of Medial Temporal Cavernous Angioma in Dominant Hemisphere after Subdural Grid Electroencephalographic Study

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ABSTRACT

We report the treatment of a patient suffering from intractable epilepsy caused by a large cavernous angioma in the hippocampus of his dominant hemisphere. Surgical removal of a lesion and epileptic focus located in the surrounding brain tissue significantly improves seizure conditions. However, total removal of a large cavernous angioma in the medial temporal structure of dominant hemisphere is occasionally difficult because of the depth of the lesion and its contiguity with eloquent brain structures. Furthermore, when an intracranial electrocorticogram with grid electrodes is adopted, swelling of soft tissue caused by the initial operation for the installation of the grid electrodes narrows the operative view obtained by conventional frontotemporal craniotomy. We added a zygomatic osteotomy to the operative procedure for the present patient, and this enabled us to push soft tissue down and away from the operative field to provide a wider operative corridor through which total removal of the lesion and epileptic focus was accomplished. The patient has had a favorable postoperative course without suffering any seizure for 4 years.

Key words: *Intractable temporal lobe epilepsy, Cavernous angioma, Zygomatic osteotomy, Intracranial recording*

Cavernous angioma in the temporal lobe is one of the common causes of medically intractable temporal epilepsy[1)]. Removal of the lesion and epileptic focus in adjacent brain tissue brings about long-term remission of epilepsy[2,12)].

The selection of the surgical approach makes total resection available even in the case of a vascular anomaly that is located in the medial basal temporal lobe[5,13,15)]. Standard anterior temporal lobectomy is generally performed via a frontotemporal craniotomy, and medial temporal structures are removed via an anterior medial temporal resection through the space in which the anterior temporal brain cortex is resected. Furthermore, this cortical resection also makes sufficient space to remove the medial temporal lesion that supervenes and causes epilepsy. However, the corticotomy is generally restricted for fear of a postoperative speech function deficit in the dominant hemispheric temporal lobe[3)], and soft tissue swelling after the craniotomy would constrict the operative corridor further if the installation of intracranial electrodes occurs. We report a case in which an angioma and epileptic focus were successfully resected through an operative field widened by additional zygomatic osteotomy after subdural grid electroencephalographic study.

CASE REPORT

An otherwise healthy, twenty-two-year-old left-handed male was referred to our clinic with complaints of attacks of unconsciousness with automatism. He was born at full term and had no particular family history of epilepsy. He had suffered from a heavy chest sensation and nausea several times a month since he was 15 years old. These events became more frequent in the follow-

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ing years. Since he was 19 years old, family members had noticed several attacks of loss of consciousness accompanied by automatism in his extremities. A local neurologist pointed out EEG abnormalities and a lesion, supposedly a cavernous angioma, in his right hippocampus on MRI. The patient was put on 600–800 mg/day carbamazepine with a diagnosis of symptomatic temporal lobe epilepsy. However, the seizure condition did not improve. The patient, a student attending a postgraduate technology school, could not accept his seizure condition.

Neurological assessment

Neurological examination was normal. His cognitive function was good with a Wechsler Adult Intelligence Scale-Revised (WAIS-R) score of 116. Aura, a heavy sensation on his chest and nausea appeared once a week. Automatism of his extremities, and purposeless movement under compromised consciousness, occurred once or twice a month. Interictal scalp EEG showed sporadic spikes in the right frontal and temporal region. MRI showed a large cavernous angioma, 2.5 cm in diameter, surrounded by hemosiderin deposition in the right hippocampus (Fig. 1). Another hemosiderin deposition, presumably another tiny angioma, was discovered in the middle temporal lobe. Cerebral angiography did not show any abnormality. IMP-single photon emission tomography (SPECT) in the interictal state revealed low perfusion in the right medial temporal region. The amobarbital test demonstrated his speech and memory function to be situated in the right cerebral hemisphere. Functional MRI also showed his speech center to be located in the right temporal lobe. Scalp EEG-video monitoring showed that the seizure discharge originated in his right temporal lobe.

Treatment Strategy

Based on the patient's history and the results of neurological examinations, the cavernous angioma was judged to have caused the temporal lobe epilepsy. Temporal lobectomy and resection of the cavernous angioma with surrounding gliotic brain tissue seemed a reasonable choice for controlling the patient's seizures. Sufficient cortical resection was necessary for resection of the deep-seated large cavernous angioma. The amobarbital test and functional MRI indicated that the right hemisphere was dominant for his memory and speech function. To determine the exact epileptogenic focus and brain function surrounding the angioma, an initial frontotemporal craniotomy for installation of subdural grid electrodes was performed. Video-EEG monitoring using these intracranial electrodes clearly showed that the epileptic discharges originated in medial temporal structures, adjacent to the angioma, including the hippocampus and amygdala.

Functional mapping derived from electrical cortical stimulation revealed his memory-related speech center to be located 5 cm from the tip of the temporal lobe. To avoid postoperative speech dysfunction, corticotomy of the temporal lobe should be limited to 4 cm from the temporal tip. The superior temporal gyrus should also be spared because it might involve speech function. Thus, the direction of the operative approach should be from an anterolateral-inferior to posteromedial-superior and not from a lateral to medial direction.

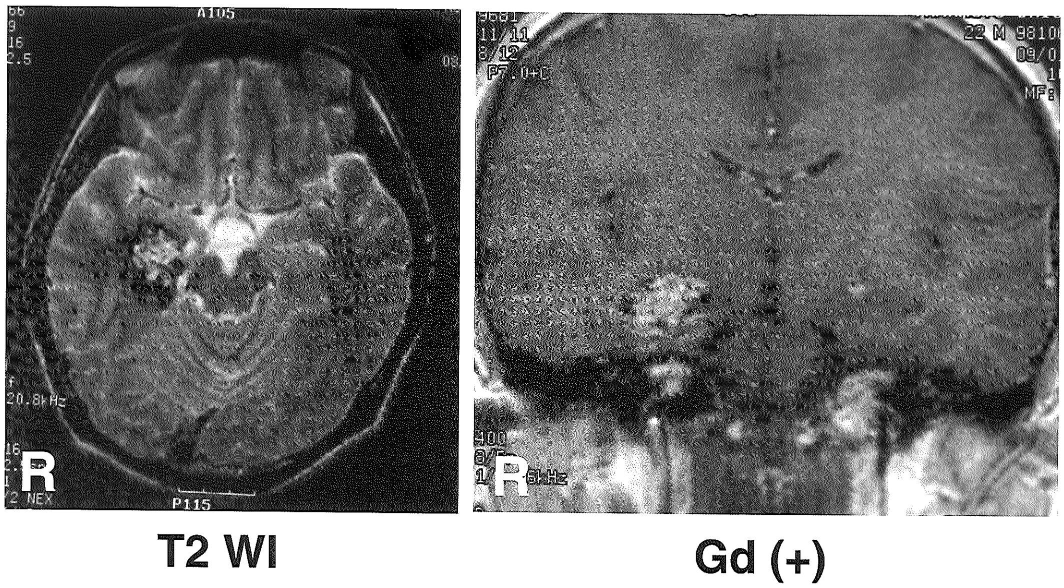

Fig. 1. Preoperative MRI.
A cavernous angioma located in the right hippocampus is shown.

Surgical Procedure

The resection of the angioma and epileptic focus was attempted two weeks after the first surgery for installation of intracranial electrodes. Conventional frontotemporal craniotomy was performed in the same manner as the preceding operation.

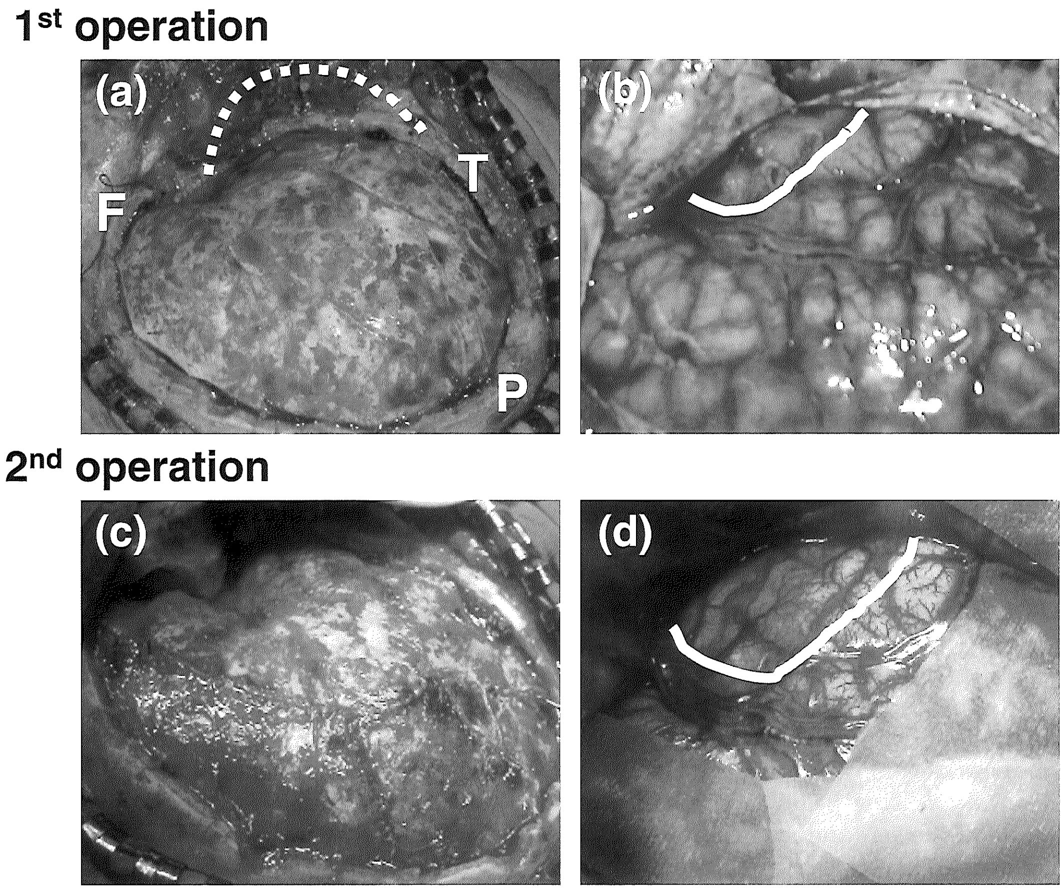

Fig. 2. Operative field obtained from common and additional craniotomy.
Exposure of dura matter (a) and brain surface (b) after common craniotomy. Sufficient exposure of dura matter (c) and temporal lobe (d) after additional zygomatic osteotomy. White broken line indicates the margin of additional craniotomy performed in the second operation, and white line shows the margin of temporal corticotomy that was planned in second operation. Abbreviations indicate frontal (F), temporal (T), and parietal (P) side.

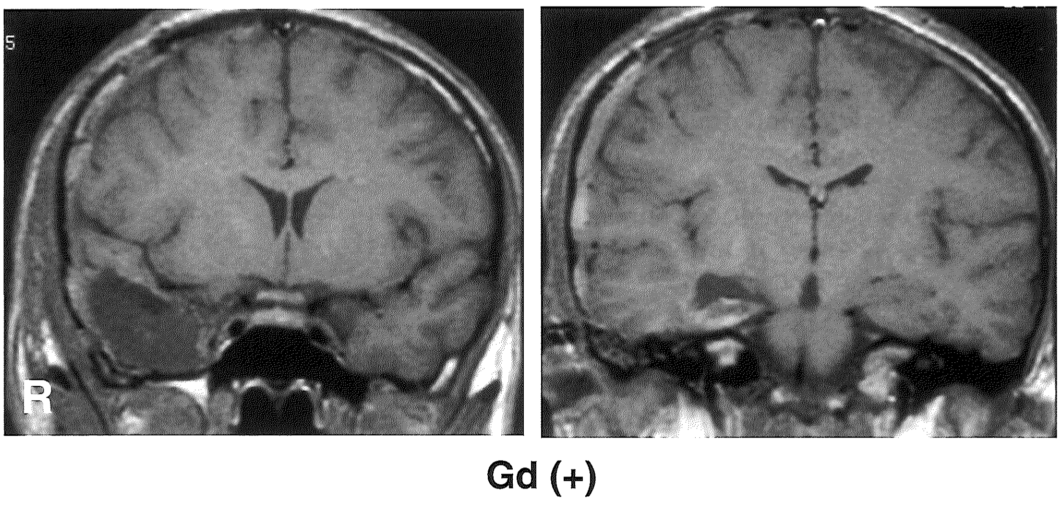

Fig. 3. Postoperative MRI.
Anterior temporal lobectomy was performed and a cavernous angioma in the right hippocampus was totally extirpated.

The operative field through the craniotomy was restricted, especially in the anteroinferior quadrant, by the swollen temporal muscle. Therefore, a zygomatic osteotomy was added to the procedure. Removing the zygomatic arch enabled the swollen temporal muscle to be dislocated downward and away from the operative field. Sufficient exposure of the temporal lobe was obtained by this procedure (Fig. 2). The temporal lobe cortex was resected up to 4 cm from its tip, sparing the superior temporal gyrus. Through the space in which the cortex was removed, the parahippocampal gyrus and amygdala were also removed. The cavernous angioma and hemosiderin tainted gliotic tissue, including the hippocampus were then totally resected (Fig. 3).

Postoperative Course

The immediate postoperative course was uneventful. No speech or cognitive dysfunction was observed. Postoperative MRI demonstrated the total removal of the angioma and surrounding hemosiderin tainted tissue. The patient has been postoperatively seizure-free under a tapering dose of carbamazepine for 4 years.

DISCUSSION

Cavernous angioma can cause repeated microbleeds, and induces degeneration and gliosis in the surrounding brain[7,8]. This brain tissue can often become an epileptic focus, and sufficient resection of focus including hemosiderin tainted gliotic parenchyma is necessary for the control of epilepsy[1,2]. In the present case, a cavernous angioma was accompanied by a wide area of gliotic tissue located in medial temporal structures. To remove a lesion in the posterior side of the medial temporal lobe, subtemporal approach and transcortical transventricular approach will be also considered[5,15]. Wide separation of Sylvian fissure can also make it easy to remove lesions located in the anterior side of the medial temporal lobe[14,15]. However, a full operative field is desirable for treating small feeding arteries and draining veins which are not clearly revealed upon angiography, without injuring hippocampal arteries and other important small branches. Anterior temporal lobectomy was planned in this patient beside the resection of the cavernous angioma as the result of EEG and ECoG study, and this lobectomy provides a suitable route for removal of large medial temporal lesions. On the other hand, the operative field for treatment of medial structures is usually narrow because resection of the temporal cortex in the dominant hemisphere should be limited to within 5 cm from the tip of the temporal lobe[3], and the swelling of the skin flap after the initial operation restricts the operative field. Therefore, the transzymatic craniotomy was added to obtain sufficient reflection of the skin flap and give an easy surgical access. This approach made it possible to look at the medial structure from the low and anterior side, conserving the superior temporal lobe that has only a low correlation as being a source of seizure.

Transzygomatic craniotomy is well known as a fronto-orbitozygomatic approach using jointly frontotemporal craniotomy and osteotomy of the orbital roof, and is often selected to treat tumors located in the skull base and basilar aneurysms[4,11]. This type of craniotomy is also used for the surgery of intraorbital tumors[9], and we adopted elements of this approach for this case. As a skin incision up to the ear edge and substantial rolling down of a skin flap is required using this approach, injury to the first branch of the facial nerves has become one of the major complications of this approach, but a technique using dissection of the temporal fat pad reduces the risk of damage to facial nerves[16]. Moreover, the cosmetic outcome associated with the operation is also improved because titanium plates tightly fix the bone pieces[10] and conservation of the temporal fascias prevents atrophy of the temporal muscle[6].

We propose that transzygomatic craniotomy should be considered in the conditions of anterior temporal lobectomy where in the dominant hemisphere: (i) subdural electrocorticographic recording or electrical cortical stimulation is necessary for the treatment of epileptic focus, and (ii) resection of a large intracranial lesion in a medial temporal region is required.

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