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Case Report

Modified Electroconvulsive Therapy for Recurrent Major Depressive Disorder in a Meningioma Patient: A Case Report of Clinical Experience

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Abstract Electroconvulsive therapy (ECT) is primarily indicated for mood disorders and schizophrenia. Clinicians may encounter cases in which ECT is administered to patients with various kinds of complications. However, to our knowledge, no detailed medical guideline is available about the indications for ECT in psychiatric illness complicated with a concomitant brain tumor, which is one of the most likely physical complications that can directly affect ECT. We report a case in which 3 courses of modified ECT (m-ECT) were successfully administered without any neurological deterioration to a patient, who was frequently hospitalized for recurrent depressive disorder with stupor. We did not undertake any additional measures for reducing adverse events derived from the meningioma during m-ECT. In this report, we discuss the relation between brain tumor and depression.

Key words: modified electroconvulsive therapy, depression, meningioma, brain tumor, risk, intracranial space-occupying lesion, intracranial tumor, intracranial mass

Introduction

Modified electroconvulsive therapy (m-ECT) is considered to have high safety. It has been considered that there are no absolute contraindications for m-ECT1). Clinicians may therefore encounter cases in which ECT is administered to patients with various kinds of complications. However, to our knowledge, no detailed clinical guideline is available about the indications for electroconvulsive therapy (ECT) in patients with brain tumors. When ECT is administered to patients with brain tumors, it is necessary to evaluate the risks and benefits very carefully in cooperation with doctors from other departments to prevent complications as much as possible.

We previously reported the case of a patient with a right parietal meningioma who underwent 2 courses of m-ECT when she experienced recurrent major depressive disorder with stupor2). In the present paper, we report the case of a patient who received 3 courses of m-ECT, including previously reported information. In addition, we discuss the relation between brain tumor and depression and between meningioma and increased seizure threshold.

Case report

In our previous report, published in Japanese, we have described the case of a patient being studied here who underwent 2 courses of m-ECT2). This case study summarizes the previous findings and is followed by a report on the third course of m-ECT. Some information of the patient was intentionally changed to protect the patient’s privacy.
A 65-year-old woman was admitted to the psychiatric inpatient unit at our hospital for evaluation and treatment of depression. She was married, retired, and a full-time housewife, living with her husband. After her husband had a stroke and a relative had died at the same time, approximately 3 months before admission, she had gradually become depressed. She was treated with amitriptyline (100 mg/day) in the outpatient facility, but failed to respond. She was subsequently referred to our hospital for evaluation and medication.

Her past psychiatric history was negative and her family history revealed that her younger brother had depression.

We performed head computed tomography (CT) of the patient to exclude organic diseases. The CT showed a 6-mm right parietal intracranial space-occupying lesion with calcification. A magnetic resonance imaging (MRI) study was also performed, and we consulted neurosurgeons about her intracranial space-occupying lesion. The lesion was found to be a benign meningioma and surgery was not indicated.

The patient’s amitriptyline dose was increased to 150 mg/day. However, her depression symptoms did not improve and she tended to refuse meals and medicine. The amitriptyline dose was gradually decreased while that of milnacipran gradually increased to 100 mg/day in order to replace amitriptyline. The patient’s psychomotor retardation continued to deteriorate and she became stuporous at 20 days after admission. Because the oral intake was limited, nutrition management was performed using a peripheral vessel drip. The patient’s general physical status became extremely weak and we needed to resolve not only her psychiatric symptoms, but also the debilitation of her body. Therefore, we chose not to wait for the drug therapy to become effective but concluded that administration of m-ECT was required. On the 25th day after admission, bilateral m-ECT was initiated for the patient, to be performed 3 times a week, using a brief-pulse square wave stimulator (Thymatron; SOMATICS, LLC, USA). The patient recovered promptly from the stuporous condition. She was able to eat by herself after the second m-ECT session. Her dietary intake also increased. She recovered from depression after the fourth m-ECT session. In total, 6 m-ECT sessions were conducted during this period. The data, dose of anesthetic and muscle relaxant, percentage of energy and seizure duration of each ECT session are summarized in Table 1. She was discharged on the 45th day after admission.

After discharge, the patient was in remission from depression and continued recovering while taking milnacipran (100 mg/day). When she experienced lower back pain 4 years later, she became depressive again. She also reported mild anxiety and agitation. It became impossible for her to understand the necessity of psychiatric treatment; therefore, she was admitted to our hospital for the second time.

After admission, the patient’s dosage of milnacipran was increased to 150 mg/day, but her anxiety and agitation became severe. Quetiapine (225 mg/day) was administered for sedation and some improvements were noted. However, the patient became stuporous again. It is possible that augmentation therapy may have been effective. However, to speed up the improvement of her psychotic manifestations and because her nutritional status had deteriorated significantly, we again considered m-ECT for treatment. We consulted the neurosurgery staff again. No increase in the size of the tumor was noted on the head CT (Fig. 1a); the meningioma was small in size and stable. The patient did not exhibit any symptoms of intracranial hypertension. We concluded that we could perform m-ECT with a high degree of safety, as in the previous hospitalization. We explained the possible complications of m-ECT with regard to meningioma and obtained informed consent. Her husband supported the administration of m-ECT because the previously conducted
Fig. 1  a: Image of the head (CT) during the second hospitalization. A tumor with plain boundary and calcification, with a diameter of 6 mm, can be seen in the right parietal lobe. Mass effects such as midline shift and edema changes are not evident.

b: Image of the head CT during the third hospitalization. No increase in the size of the tumor is noted compared with the CT scan from the second hospitalization.
m-ECT had dramatically improved his wife's stupor. A series of 6 m-ECT sessions were performed using a method similar to that applied during the first course of m-ECT in her previous hospitalization. The patient showed no adverse effects and her depression achieved remission status. The patient was discharged. For outpatient maintenance, she continued treatment with paroxetine 30 mg/day.

In the outpatient facility, the patient's drug compliance was good; however, she became anxious and agitated, without any obvious cause, when she turned 70. She reported depressed mood, anhedonia, severe anxiety, agitation, and weight loss. The dose of paroxetine was increased to 40 mg/day, but she failed to respond. Her suicidal ideation increased, her appetite decreased, and she was again admitted to the hospital.

When the patient was admitted to our hospital, the results of her physical and neurological examinations were negative. The values for serum chemistry, thyroid hormone, complete blood count, and urinalysis were within normal limits. Her electrocardiogram (ECG) was normal. Chest radiograph revealed a slight calcification of the aorta, but no pulmonary diseases.

During the examination of her mental status, the patient showed psychomotor retardation and reported suicidal ideation. She had delusions of guilt, complaining that she had committed a crime against her family. She met the criteria for major depression, severe with psychotic features (DSM-IV-TR 296.24). Her score on the Hamilton Depression Rating Scale (HAM-D) at admission was 31.

We performed another head CT to examine her meningioma. We found no increasing trend in the size of the meningioma as compared to her 2 previous hospitalizations (Fig. 1b). The electroencephalogram (EEG) showed normal background activity and we found no epileptic discharges.

Lithium was added to the paroxetine treatment and increased to 400 mg/day as augmentation therapy. Her lithium blood level was 0.7 mEq/l. We did not observe any improvement with regard to her depression symptoms. We decreased the paroxetine dose gradually in order to replace it eventually with milnacipran. The dose of milnacipran was gradually increased to 100 mg/day. Her psychomotor retardation decreased and she gradually recovered. We determined that her anxiety and agitation had almost disappeared, and her depression went into remission. Together with her family members, we decided that she could be released from the hospital to stay for a few days at home. After several trial stays at home, her status gradually began to deteriorate and she became extremely agitated at 2 months after admission. We tried several kinds of antidepressive agents, including sertraline and mirtazapine, for appropriate durations with proper doses, but the patient failed to respond. We thought that she had developed drug-resistant agitated depression. Therefore, we again considered m-ECT as a treatment method, evaluated it for safety, and consulted this option with the neurosurgeons. No clinical conditions such as headache, nausea, or convulsions were observed and the funduscopic examination did not reveal abnormal findings. Based on these findings, the possibility that the patient would have an increase in the intracranial pressure was considered very low. In addition, the meningioma was of small volume and calcified. Neither cerebral edema nor a midline shift was noted (Fig. 1b).

We concluded that the meningioma scarcely affected the choice of m-ECT. We explained the possible complications of m-ECT when performed in the presence of a brain tumor to her family members and obtained informed consent from her family. While the m-ECT was performed, administration of sertraline was continued and that of lithium was discontinued. On the 105th day after admission, bilateral m-ECT was started and performed at a frequency of 3 times per week using a brief-pulse square wave.
stimulator. She was anesthetized by the anesthesiologist in the operating room with thiopental sodium (200 mg–150 mg, intravenously); suxamethonium (60 mg) was given as muscle relaxant. The electrical dosage began at 35%, according to the formula-based “half-age” method. We defined effective m-ECT as maintaining seizure on the EEG for 15 seconds or more; if this was not observed, the electrical dosage was increased by a factor of 1.5 and the patient was re-stimulated. We observed that the patient improved just after the first m-ECT session. The extreme agitation disappeared and she could speak calmly. Her HAM-D score was 5 and her depression went into remission after the 6th m-ECT session (Table 1). Because no adverse effects were observed during the series of 6 m-ECT sessions, and because her depression went into remission, she was discharged on the 130th day after admission. The clinical and pharmacotherapy course of the 3 hospitalizations is summarized in Figure 2.

**Discussion**

It is generally accepted that no absolute contraindication exists for the use of m-ECT. However, when ECT is performed in patients with an existing brain tumor, it is known that excessive intracranial perfusion occurs and that the intracranial circulating blood volume increases, which is thought to lead to a high risk of brain herniation\(^3\). In a task force report of the American Psychiatric Association, the presence of “increased intracranial pressure caused by brain tumor and other brain space occupying lesions” has been considered a “specific condition that may be associated with a substantially increased risk”\(^1\). When a brain tumor is large, multiple, or edematous, or in cases of increased intracranial pressure or with exclusion effects, these conditions are thought to be relative contraindications for ECT\(^4\). Due to the existence of meningioma, we discussed and examined the safety of performing m-ECT in the case described here in relation with neurosurgery during each of the 3 hospitalizations. The following factors are thought to be predictors of prognosis when ECT is conducted in the presence of a brain tumor: 1) cerebrospinal fluid pressure, 2) symptoms of intracranial hypertension, 3) type, size, and location of the brain tumor, 4) edematous changes around the tumor, 5) neurological findings, and 6) prior therapeutic gains with ECT\(^1\). In the case discussed in this report, we did not observe clinical conditions such as headache, nausea, or convulsions. The funduscopic examination did not reveal abnormal findings. On the basis of these findings, we thought that the

![Fig. 2](image.png)
possibility of an increase in the intracranial pressure was very low. In addition, the meningioma was of small volume, calcified, and did not invade the bone. We did not see cerebral edema or midline shift. For these reasons, we concluded that we could perform m-ECT in the patient without additional methods to lower the intracranial pressure, including administration of anti-hypertensive drugs, steroids, diuretic agents, and hyperventilation.

We believe it is possible that the type and origin of the brain tumor are related to the risk of adverse effects of ECT. It has been reported that successful ECT without adverse effects was performed in patients with malignant tumors, astrocytoma, or neuroblastoma41-6. However, an unsuccessful ECT with adverse effects (i.e., impaired consciousness) in patients with glioblastoma has also been reported9.

Meningiomas accounts for 13-26% of all intracranial tumors; 90% or more are benign, and the 5-year survival rate is 80% or greater8. Several case reports exist in which successful ECT was performed in psychiatric patients with meningiomas of various sizes and different origin (Table 2)249-12. Serious adverse events (e.g., coma) occurred after ECT in psychiatric patients with meningiomas1314. However, this seemed to be related to unrecognized meningioma before performing ECT.

In the 3 courses of m-ECT conducted in the patient in this case report, the percentage of energy applied with the Thymatron was relatively high, increased over time, and finally reached 100% (504 mC) (Table 1). When using brief-pulse square wave stimulators, the electrical current is always the same. When using the Thymatron, the energy percentage was calculated using time (s) and electrical current (A) which was calculated using impedance and electric potential15. Before reaching the brain, the electrical current must pass through the cranial bone which has a high resistance1617. It has been proposed that the contour of the cranial bone could possibly affect the seizure threshold in ECT1718. Hyperostosis or bone invasion sometimes follows meningioma. Therefore, the existence of meningioma might affect the seizure threshold and result in relatively high impedance, allowing 100% energy to be applied after a low number of ECT sessions. In the case presented here, the meningioma was adjacent to the skull and showed calcification. However, it was relatively far from the sites where the electrodes for ECT were positioned.

<table>
<thead>
<tr>
<th>case</th>
<th>size and origin site of meningioma</th>
<th>medication therapy during ECT</th>
<th>electrode position</th>
<th>course number of ECT</th>
<th>number of ECT enforcement</th>
<th>effect of ECT</th>
<th>adverse event</th>
</tr>
</thead>
<tbody>
<tr>
<td>73y/o, female, depression</td>
<td>cerebellopontine angle,1.0 × 17 cm, after gamma knife surgery</td>
<td>n.i.</td>
<td>bilateral</td>
<td>7times</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>54y/o, male, major depression</td>
<td>1.5 × 26 cm remaining frontal meningioma after craniotomy</td>
<td>none</td>
<td>bilateral</td>
<td>7times</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>40s, female, depressive illness</td>
<td>n.i.</td>
<td>n.i.</td>
<td>1</td>
<td>n.i.</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>73y/o, female, major depression</td>
<td>right frontoparietal area, 5-6 cm</td>
<td>none</td>
<td>bilateral</td>
<td>7times</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>74y/o, male, depression</td>
<td>right frontal, 1.0 cm × 1.5 cm</td>
<td>none</td>
<td>unilateral</td>
<td>6times</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>50 or 49y/o, female, depression</td>
<td>left parietal</td>
<td>n.i.</td>
<td>n.i.</td>
<td>9times</td>
<td>n.i.</td>
<td>n.i.</td>
<td>effective</td>
</tr>
<tr>
<td>50y/o, female, major depression</td>
<td>meningioma was removed with a bony defect</td>
<td>imipramine, trifluoperazine, phenytoin and insulin</td>
<td>bilateral</td>
<td>9times</td>
<td>effective</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>65y/o, female, Depression</td>
<td>right parietal, O6mm</td>
<td>milnacipran</td>
<td>bilateral</td>
<td>6times</td>
<td>effective</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>69y/o, female, Depression</td>
<td>right parietal, O6mm</td>
<td>paroxetine</td>
<td>bilateral</td>
<td>6times</td>
<td>effective</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>70y/o, female, Depression</td>
<td>right parietal, O6mm</td>
<td>sertraline</td>
<td>bilateral</td>
<td>6times</td>
<td>effective</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

n.i. not identified
Furthermore, though the meningioma was considered stable during the 3 ECT courses without change in its size, hyperostosis or bone invasion, the percentage of energy applied with the Thymatron increased over time. Generally, it might be possible that the location and calcification of the meningioma could cause an increase in the seizure threshold. However, in our case, the increased seizure threshold did not directly result from meningioma. Instead, it might have resulted from dehydration or other reasons.

Feigin reported a man with depression who committed suicide. They found a large meningioma in the frontal lobe at autopsy. The meningioma was believed to have caused depression which contributed to his death. Although depression can be caused by brain tumors, the underlying mechanisms are not well understood. Besides the type of brain tumor, the size and location have also to be considered. Brain tumors in the frontal, diencephalic, and left hemisphere are associated with depression. With regard to size, tumors greater than 4 cm in diameter are also associated with depression. We could not definitely exclude the possibility that the type, size or location of the meningioma may be related to the onset and progression of depression. Further studies are needed to reach conclusions regarding the relationships between meningioma and increased seizure threshold and between brain tumor and depression.

**Conclusion**

We present here a case in which 3 successful courses of m-ECT, without any adverse events, were performed in a patient who was diagnosed with recurrent depressive disorder with stupor. The m-ECT should be discussed as one possible choice of therapy in patients with meningioma if prompt improvements of the psychiatric symptoms are needed. Before conducting ECT, it is important to understand the characteristics of the brain tumor, including its kind, size, and origin, along with any edematous changes, cerebrospinal fluid pressure, and neurological findings. The seizure threshold with ECT may be affected by the size, location, and calcification of the meningioma, bone invasion, and/or hyperostosis adjacent to the meningioma. Brain tumors at specific sites of the brain may contribute to the onset and/or treatment-resistance of depression. Further studies are needed to reach conclusions regarding the relationships between meningioma and increased seizure threshold and between brain tumor and depression.

**References**


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髄膜腫を合併した難治性うつ病に対して、
電気けいれん療法を施行した経験

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電気けいれん療法（ECT）は、気分障害や統合失調症に対して、良好な成績を上げている治療法である。実際の臨床場面では、様々な身体合併症をもつ患者にECTを施行しなければならないことがある。ECTに対して直接影響を及ぼす身体疾患の一つが、髄膜腫である。髄腫を合併した精神疾患にECTを施行するための、有用な指針は存在しない。今回我々は、髄膜腫を合併した難治性うつ病の患者に対して、修正型電気けいれん療法（m-ECT）を行った。有害事象は生じず、完全覚解した。その後うつ病が再発を繰り返したため、m-ECTを、合計3コース行った。その経過を報告するとともに、髄膜腫とうつ病の発症やECTのけいれん閾値の関係について、文献的考察を行った。