

## 측뇌실 삼각에 발생한 뇌실내 수막종에 있어 상부 두정-후두 피질경유 접근법의 임상 결과 ; 24례 보고

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### Clinical Results of the Superior Parieto-Occipital Transcortical Approach for Intraventricular Meningiomas in the Trigone of Lateral Ventricle ; A Report of 24 Cases

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#### ABSTRACT

**Introduction :** Intraventricular meningiomas are uncommon subtype of intracranial meningiomas. Trigonal meningiomas consist of the majority of intraventricular meningiomas. The superior parieto-occipital transcortical approach is the most popular approach for removal of them. We analyzed our experience in removal of the trigonal meningiomas that were resected using the superior parieto-occipital transcortical approach.

**Patients and Methods :** Twenty-four patients underwent surgical removal of trigonal meningioma from 1997 to May 2012. Demographics, clinical features, surgical outcomes, histopathologic results and prognosis were analyzed.

**Results :** Study population had a mean age of 51.2 years and a female preponderance of 1 : 1.7. The most common presenting symptom was chronic headache, which was followed by memory impairment, visual disturbance and hemiparesis. Total removal of the tumor was achieved in all cases. Twenty-two (91.7%) tumors were World Health Organization (WHO) grade I while two cases were WHO grade III. There were two cases of intracerebral hemorrhage in the surgical corridor, one case of transient contralateral hemiparesis with cognitive decline, one case of transient contralateral homonymous hemianopsia, one case of aggravation of visual field defect, and one case of hydrocephalus which was successfully treated by ventriculo-peritoneal shunt.

**Conclusion :** The superior parieto-occipital approach is suitable for most of the trigonal meningiomas and total removal of them can be achieved safely.

**KEY WORDS :** Intraventricular meningioma · Surgical approach · Trigone · Atrium · Superior parieto-occipital · Posterior transcortical.

#### Introduction

Intraventricular meningiomas are relatively uncommon subtype of intracranial meningiomas consisting of 0.5 to

3.9%.<sup>1,6,7)</sup> Among intraventricular tumors, meningiomas consist of 14.5 to 30% of all tumors being one of the common kinds as neurocytomas, subependymal giant cell astrocytomas and ependymomas.<sup>2,7,9)</sup> Intraventricular meningiomas

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can be classified according to the location, and the trigone of lateral ventricle is the most common site.<sup>3,6,7,9,12)</sup>

Unique features of the trigonal meningiomas are absence of dural attachment and an attachment to the choroid plexus.<sup>6,10)</sup> Due to their location, surgical removal inevitably ends up in violation of adjacent neural structures including eloquent cerebral cortexes.<sup>5,8)</sup> In order to minimize neurologic complications, several surgical approaches have been introduced.<sup>4,8,9)</sup> In this era of microsurgery and image-guided surgery, the superior parieto-occipital transcortical approach, also known as the posterior transcortical approach or the superior parietal lobular approach, is the most popular approach for removal of the trigonal meningiomas.<sup>10,11)</sup>

In this study, we retrospectively analyzed our recent clinical data of 24 trigonal meningiomas which were resected using the superior parieto-occipital transcortical approach.

## Patients and Methods

### 1. Study population

From 1997 to May 2012, 24 patients underwent surgical removal of the trigonal meningioma at the department of Neurosurgery in Severance hospital. Their medical records including operative records and follow-up data, image studies and histopathologic results were analyzed retrospectively. All of 24 trigonal meningiomas were resected using the superior parieto-occipital transcortical approach.

### 2. Operative procedure

The patient was in the supine position with the head rotated to the contralateral side. Inverted-U shaped skin incision was made over parieto-occipital area and craniotomy was done under assistance of an intraoperative image-guided navigation system. Cortical incision was made at the paramedial surface one to two centimeters posterior to postcentral sulcus in the direction parallel to the long axis of superior parietal lobule. After visualization of tumor, an ultrasonic aspirator was used for internal decompression. Tumor was resected in en bloc fashion after devascularization. A ventricular drainage catheter was placed and maintained for 2–5 days after the operation in most of cases.

## Results

### 1. Demographics and clinical features

There were 9 male patients and 15 female patients whose

ages were ranged between 29 and 75 years old with an average of 51.2 years old. There was left-side preference of lesion and the left-to-right ratio was 1.7.

The most common symptom was chronic headache which was reported by 14 of 24 patients. Six patients suffered from memory impairment, and visual disturbance was seen in four patients. All of four patients with visual disturbance were appeared to have contralateral homonymous hemianopsia on the examination. One patient presented with mild right hemiparesis which affected lower extremity more. Mean length of time from the first symptom onset to the definite diagnosis was 9.4 months ranging from one to 26 months. In three patients, the tumor was detected incidentally during either health check-up or evaluation for mild head trauma. We decided to remove the tumor considering high likelihood of clinical deterioration, which was inferred from the perilesional edema and the infringing mass effect of the lesion.

Grossly total removal of the tumor was achieved in all cases. After the surgery, we followed up the patients from one month to 12 years, with a median duration of 29.2 months. Demographics and clinical features are summarized in Table 1.

### 2. Surgical morbidity and neurologic outcome

There was no surgical mortality in this series. Intracerebral hemorrhage along the surgical corridor occurred in two cases. This was considered to be a traction injury rather than infarct-hemorrhage from a vessel injury as vascular territory could not be matched to the location of hematoma. The lesion was located in the dominant hemisphere in both cases and the patients had difficulty in naming and recalling. Their verbal fluency and cognitive function were declined. These conditions were completely resolved during the hospital stay in one case, and the speech impairment lingered, although improved, till one year after the operation in the other case.

**Table 1.** Demographics and clinical features

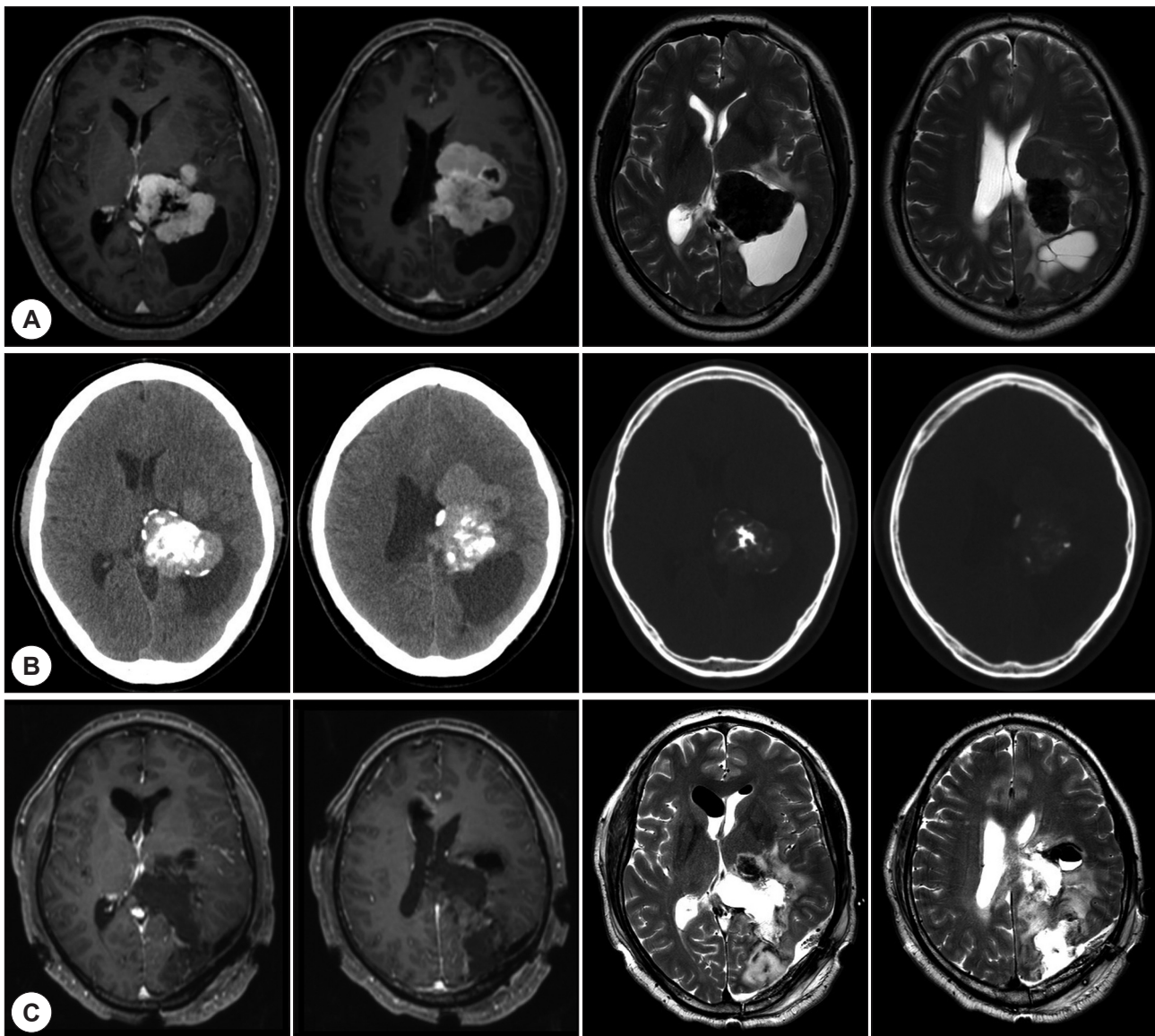
Mean age	51.2 (23–75)
Sex ratio (male : female)	9 : 15 (1 : 1.7)
Lesion side ratio (right : left)	9 : 15 (1.1.7)
Presenting symptoms	
Chronic headache	14 (58.3%)
Memory impairment	6 (25.0%)
Visual disturbance	4 (16.7%)
Contralateral hemiparesis	1 (4.2%)
Incidental	3 (12.5%)
Mean length of time to diagnosis (months)	9.4 (1–26)
Median follow-up duration (months)	29.2 (1–144)

Verbal impairment with cognitive decline was observed in one dominant-sided case. The patient also showed mild contralateral hemiparesis, but definite lesion could not be found in image studies. These symptoms were recovered in one month after the operation.

Visual field defect was aggravated in two cases. Dense contralateral homonymous hemianopsia was noted during immediate postoperative period in a patient who did not have visual field defect before the operation. Her visual symptom was almost completely resolved by one month after the operation. In the other case, the patient had blurred vision in the contra-

lateral half of his visual field before the surgery. The patient complained aggravation of visual disturbance after the operation and this remained static during the follow-up period.

The patient who presented with mild right hemiparesis exhibited cognitive decline and aggravation of hemiparesis after the operation. Although he could walk independently before the operation, he could only ambulate on a wheelchair postoperatively. After 2 months including 6 weeks of comprehensive rehabilitation, he regained the ability to walk independently. The cognitive function was also improved although the patient remained to be confused mildly (Fig. 1).



**Fig. 1.** Magnetic resonance imaging (MRI) of the 47-years old man who presented with mild right hemiparesis. A : Preoperative MRI, T1-weighted gadolinium-enhanced images (two images on the left) and T2-weighted images (two images on the right). B : Preoperative computed tomography (CT) scan, soft tissue window (two images on the left) and bone window (two images on the right). Note that bony structure is formed both superficially and inside. C : Postoperative MRI, T1-weighted gadolinium-enhanced images (two images on the left) and T2-weighted images (two images on the right). Note that enhancing and calcified lesion was removed totally.

Hydrocephalus was noted in one case and the patient eventually underwent ventriculo-peritoneal shunt. His symptoms of headache and gait disturbance were recovered after the diversion surgery. No other remarkable surgical morbidity was seen.

### 3. Histopathologic results

The majority (91.7%) of tumors were World Health Organization (WHO) grade I. There were two cases of WHO grade III meningioma while WHO grade II meningioma was not reported. These two patients received adjuvant three-dimensional conformation radiotherapy.

### 4. Prognosis

Headache was improved during the hospital stay in most of cases. Visual field defect, memory impairment and motor weakness were recovered more insidiously. Most of the patients felt improvement by one month after the operation.

The tumor did not recur during the follow-up period in all the patients.

## Discussion

Intraventricular meningiomas are inclined to occur in the lateral ventricles. Incidence in each ventricle was reported to be 77.8% for the lateral ventricle, 15.6% for the third ventricle and 6.6% for the fourth ventricle in one meta-analysis.<sup>7)</sup> The succeeding reports also showed a clear tendency of lateral ventricular preponderance while the incidences in the third and the fourth ventricle were too low to be compared reciprocally.<sup>3,6,10)</sup> Combining the results of these three reports, lateral ventricular meningiomas consist of 87.9% followed by 6.9% for third ventricular meningiomas and 5.2% for fourth ventricular meningiomas. There were five reports which provided detailed location of tumor in the lateral ventricle, and the overall incidence were 79.8% for the trigone, 8.8% for the temporal horn, 6.1% for the body or the frontal horn, and 5.3% for the occipital horn.<sup>6-9,12)</sup>

Intraventricular meningiomas which do not have dural attachment arise from the arachnoid cell nests which physiologically reside in the stroma of choroid plexus and in the choroidal tela.<sup>3)</sup> Preference of tumor occurrence in the lateral ventricle can be attributed to the volume of choroid plexus which is far larger than other ventricles.<sup>7)</sup> Some authors distinguished growth patterns of the tumor by origins; those arisen from the choroid plexus grow within the ventricle while those arisen from the tela choroidea partially grow to the surrounding brain

parenchyme.<sup>9)</sup> Total removal of the trigonal meningiomas are feasible since they grow from the choroid plexus into the ventricular space without adhering to the adjacent brain parenchyme.<sup>8,11)</sup> The cleavage plane between the tumor and the ependyma was clear in most of our cases except two cases of anaplastic meningioma. These cases showed extensive adhesion to the ependyma with possible invasion beneath it. One distinct feature of lateral ventricular meningiomas is that they show left-side predominance for unknown reasons.<sup>3,9)</sup> Most of reports showed left-side predominance and a meta-analysis showed a left-to-right ratio of 1.4 : 1.<sup>6,7,9,10)</sup> The left-to-right ratio was 1.7 : 1 in our series and this was consistent with this left-side predominance.

Lateral ventricular meningiomas cause symptoms and signs by increasing the intracranial pressure, by compression of the surrounding brain parenchyme, or both. Previous reports uniformly stated that the majority of symptoms were elicited by increased intracranial pressure.<sup>6,7,9,10)</sup> The mass effect of lateral ventricular meningiomas are usually well compensated by a distensible nature of the ventricle.<sup>9,12)</sup> For this reason, the size of tumor is frequently as large as 8.0 cm in the longest diameter at the time of diagnosis.<sup>6,7,10,12)</sup> In our report, mean duration of symptom was 9.4 months reflecting compensation of mass effect by the ventricle as well as insidious growth of the tumor. Chronic headache and memory impairment which could be attributed to increased intracranial pressure consisted of 83.3% of the presenting symptoms while homonymous hemianopsia and contralateral hemiparesis which were usually induced by local mass effect consisted of 20.9%.

The overall rate of tumor recurrence in a meta-analysis was 8 out of 201 cases (4.0%) among which the total resection rate was 92.5%.<sup>10)</sup> There was no tumor recurrence during the follow-up period in our series in which total resection was achieved in all the cases. In our opinion, absence of attachment to the dura mater makes the rate of recurrence low for the intraventricular meningiomas since meningiomas usually recur from the dura that was left in the resection margin.<sup>1)</sup> Still, as there were two cases of WHO grade III meningioma, there is possibility of recurrence in the future.

The trigone of lateral ventricle, which is also known as atrium, is a deep location surrounded by brain parenchyme in every direction. The most concerned structure is the optic radiation which lies in the lateral surface of trigone and runs inferolaterally.<sup>5,7)</sup> Eloquent cortexes around the trigone include primary sensory cortex, parietal association cortex, and Wer-



nicke's area in the dominant hemisphere. Since trigonal meningiomas arise from the choroid plexus, almost all feeding arteries originate from either anterior choroidal artery or posterior choroidal arteries.

After the first documented removal of a trigonal meningioma by Macdowell in 1881, several surgical approaches have been introduced<sup>5,9)</sup> Currently, three surgical approaches are in usual use for removal of the trigonal meningioma; superior parieto-occipital approach, transtemporal approach, and posterior transcallosal approach.<sup>4,7,8)</sup> Posterior part of the body of lateral ventricle is accessed in the superior parieto-occipital transcortical approach. This route pertain to minimal risk of language and motor impairment.<sup>4,8)</sup> The temporal horn is accessed through the posterior middle temporal gyrus in the transtemporal approach. This route is the shortest trajectory to lateral ventricle and enables early access to the anterior choroidal artery and the feeding arteries that arise from it.<sup>4,7)</sup> Language function and visual function are virtually not altered in the posterior transcallosal approach. Although early exposure

of posterior choroidal arteries is another advantage, use of the posterior transcallosal approach is limited since this approach is proper for only small lesions due to the limitation of callosotomy size and the difficulty in hemispheric retraction which is caused by larger tumors that hinder shifts of the brain parenchyme.<sup>4,8,11)</sup> Disconnection syndrome due to resection of the splenial fibers and mutism associated with traction of bilateral cingulate gyri also restrict the surgeons.<sup>4,11)</sup> In one study which included all kinds of the intraventricular tumors, 16 tumors were resected using the posterior transcallosal approach and two patients out of 16 had transient mutism while disconnection syndrome was not manifested.<sup>4)</sup> The characteristics of these three surgical approaches are summarized in Table 2.

The superior parieto-occipital transcortical approach is the most popular and versatile approach because it can be applied to larger lesions in most of the locations.<sup>4,8,11)</sup> Although it has been criticized for its limitation of preliminary access to the feeding arteries, internal decompression of the tumor by piecemeal removal using an ultrasonic aspirator resulted in reliable exposure of feeding arteries.<sup>6)</sup> Other two surgical approaches also have limitation over coagulation of feeding arteries; only intraventricular portion of anterior choroidal artery can be exposed with the transtemporal approach and it is quite often obscured by the tumor mass, only posterior choroidal arteries are exposed preliminary to tumor removal during the posterior transcallosal approach.<sup>7)</sup>

A major drawback of the superior parieto-occipital transcortical approach is the risk of damage to the optic radiation. Considering the route of optic radiation running inferolateral direction in the lateral wall of trigone, theoretically the surgical corridor per se does not disrupt the optic radiation.<sup>5,7,9)</sup> It has been advocated that proper cortisectomy and horizontal subcortical dissection could minimize the damage to the optic radiation.<sup>6,7,9)</sup> However, in the previous reports that provided the neurological outcome of the operation, the incidence of newly developed visual field defect ranged from 15.3% to 33.3%.<sup>4,5,8,9)</sup> Comparing with the transtemporal approach, previous reports showed that the superior parieto-occipital transcortical approach brought about relatively more injuries to the optic radiation which were manifested as homonymous hemianopsia or quadrantanopsia. Overall incidence of newly developed postoperative visual field defect was 23.7% for the superior parieto-occipital approach and 6.7% for the transtemporal approach.<sup>4,5,7,9)</sup> In our series, there were two cases of newly appeared homonymous hemianopsia. The sign was transient in one case and was thought to be caused by perile-

**Table 2.** Comparison of three popular approaches to the trigone of lateral ventricle

1) Superior parieto-occipital transcortical approach (also known as posterior transcortical approach)	
Preferred lesion	Posterior part of body, most of the trigone
Advantages	Most expedient especially for larger tumors
Shortcomings	Potential risks of damaging optic radiation and language fiber Long surgical corridor which can be cumbersome for inferior lesion Difficult access to vascular pedicle
2) Transtemporal approach/Subtemporal approach	
Preferred lesion	Extension to temporal horn, anteroinferior part of the trigone
Advantages	Direct and short trajectory to the ventricle Early exposure and control of anterior choroidal artery Relatively less damage to optic radiation
Shortcomings	Possible damage to optic radiation and speech area Risk of damaging bridging veins
3) Posterior transcallosal approach	
Preferred lesion	Midline or extending upward and medially to the posterior splenium
Advantages	Low incidence of postoperative seizure No damage to speech and visual pathway Feasible control of posterior choroidal arteries
Shortcomings	Requires more traction than the other two approaches Disconnection syndrome

sional edema resulted from vigorous traction during the surgery. In the other case, the tumor showed extensive adhesion to adjacent brain parenchyme and the histopathologic diagnosis revealed that the tumor was anaplastic meningioma. Injury to the optic radiation in this case could be regarded as an injury during the dissection around the tumor rather than an injury by the surgical corridor.

Vigorous traction during the superior parieto-occipital approach, as well as the transtemporal approach, could also end up in irritation of motor fibers. According to one report, transient contralateral hemiparesis which was reversed before the discharge appeared in two out of 11 cases using the superior parieto-occipital transcortical approach, and in one out of 4 cases using the transtemporal approach.<sup>9)</sup> In our series, there was one case of left-side lesion in which postoperative contralateral hemiparesis appeared along with cognitive decline. The symptom was fully recovered by one month after the surgery. There was one patient who presented with mild right hemiparesis. His motor function was aggravated during the acute postoperative period and was recovered to preoperative level by 2 months after the operation. This could be attributed to brain edema caused by traction or dissection around the tumor mass during the operation. In case of using the superior parieto-occipital transcortical approach in the dominant hemisphere, a paramedian route is essential in order to avoid cognitive decline or various parietal lobe dysfunctions after the operation.

### Conclusion

The superior parieto-occipital transcortical approach is suitable for most of the trigonal meningiomas. Control of feeding arteries can be reliably done after internal decompression and the risk of injury to optic radiation as well as the risk of parietal lobe dysfunction can be minimized using an optimal surgical route. Total removal of the trigonal meningioma

can be achieved safely using the superior parieto-occipital transcortical approach.

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