

# Surgery of the Tumors in the Ventricular System

Sang-Won Hong, M.D., Ha-Young Choi, M.D., Eun-Jeong Koh, M.D.

*Department of Neurosurgery, Research Institute for Clinical Medicine, Chonbuk National University  
Medical School/Hospital, Jeonju, Korea*

**Objective :** The authors study on the clinical presentations and the surgical outcomes of the tumors in the ventricular system.

**Methods :** 15 patients with ventricular tumor were studied. The clinical presentation, radiological findings, different surgical approaches, and outcome were analyzed. Tumors were classified into three groups based on their locations in MRI : lateral, third and fourth ventricle. Surgical methods were transcortical approach in eight patients, transcallosal approach in four, median suboccipital approach in two, and subfrontal approach in one. Gross total removal was achieved in 10 patients. Subtotal resections were performed in the rest. Glasgow outcome scale was used for evaluation of the surgical outcome.

**Results :** Main clinical presentations were chronic headache in patients with the tumor in the lateral ventricular tumor and sudden onset of headache and consciousness change in patients with the tumor in the third and fourth ventricular tumor. Development of hydrocephalus was more predominant in patients with the tumors in the third ventricle. Postoperatively, good outcome (Glasgow outcome scale IV, V) were in 73%, and better results was observed in patients with the tumors in the lateral ventricular tumor. The differences of outcome according to surgical approach were not recognized, even though it was not reliable statistically.

**Conclusion :** In ventricular tumor, postoperative outcome is not good in patients with sudden development of headache, hydrocephalus, high grade tumor. Outcome is good in patients with the tumor in the lateral ventricle relatively. There is no difference in outcome according to the approach method to the tumors. And it is necessary to be aware of various approach methods to the tumors and anatomy surrounding the ventricle for avoidance of neurological complications.

**KEY WORDS :** Tumor · Ventricle.

## Introduction

Intraventricular tumors are notably rare with an incidence of 3 to 10 percent among all intracranial tumors<sup>8)</sup>. Various tumors can affect this region. The clinical features include a symptoms by slowly progressive or intermittently increased intracranial pressure, mental and visual disturbances. Surgical treatment of the ventricular tumor is often challenging to have a good surgical outcome because of their location related with the important structures surrounding the tumor. Therefore, a correct understanding of anatomic features and neuronal structures around the ventricles is necessary to avoid complications after surgery. And a carefully designed and planned approach is the key for a successful surgical removal of the tumor. Authors present the clinical and radiological features, surgical outcomes, and complications on the study in 15 patients with ventricular tumor.

## Materials and Methods

We retrospectively analyzed 15 patients with ventricular tumor treated in our department between 1998 and 2003. The clinical presentation, radiological findings, surgical approaches, pathologic findings, and outcomes were analyzed using data from the archives. There were 307 surgical resection of intracranial tumors and 15 of them were intraventricular tumors. Tumors were classified into three groups based on their locations in the ventricles in MRI : lateral ventricle, third ventricle and the fourth ventricle. Surgical routes were transcortical approach in eight patients, transcallosal approach in four, median suboccipital approach in two, and subfrontal approach in one. Gross total removal was achieved in 10 patients. Subtotal resections were performed in the rest. Before resection of the tumor, eight of 10 patients with hydrocephalus were underwent extraventricular drainage of cerebrospinal fluid.

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• Address for reprints : Ha-Young Choi, M.D., Department of Neurosurgery, Chonbuk National University Medical School/Hospital, 634-18 Geumam-dong, Deokjin-gu, Jeonju 561-712, Korea · Tel : +82-63-250-1880, Fax : +82-63-277-3273, E-mail : hayoungc@chonbuk.ac.kr

No ventriculo-peritoneal shunt was performed after removal of the tumor for the treatment of permanent hydrocephalus. Follow-up period were ranged from 8 months to 57 months (mean : 25 months). Statistically, Mann-Whitney U test and Kruskal-Wallis test were used.

## Results

### Sex and age distribution

The male to female ratio was 1:1.14. The age ranged from 3 to 61 years (mean : 30 years old). Authors could not find any meaningful connections with sex and age, related with the tumors.

### Locations of the tumor

The tumors occurred in the lateral ventricle (6 patients, 40%), the third ventricle (7 patients, 47%) and in the fourth ventricle (2 patients, 13%). Tumors mainly occurred in the lateral ventricle and the third ventricle. Among six patients with tumor in the lateral ventricle, four were in the right and two were in the left.

### Clinical symptoms and signs

The presenting symptoms were variable (Table 1). The most common presentation was symptom related to elevated intracranial pressure. Headache was a major clinical symptom (10 patients, 66%) and others were mental change (5 patients), vomiting (3 patients), visual deficit (3 patients), seizure attack (2 patients), gait disturbance (1 patient), memory disturbance (1 patient) and voiding difficulty (1 patient). Symptom duration showed wide range from 1 day to 5 months. In clinical presentation, headache was chronic for several months in patients with the tumors in the lateral ventricle. Acute headache with consciousness change was observed in four of seven patients with the tumors in the third ventricle, and one of two patients with tumors in the fourth ventricle. In patients with acute symptom, loss of consciousness (5 cases) was common and surgical outcome was poor as a death in two patients and

**Table 1.** Clinical manifestations of patients

	Tumor locations			Total
	Lateral	Third	Fourth	
Headache	6	3	1	10
Decreased visual field	1	1	0	2
Change of mentality	0	4	0	4
Seizure	1	0	1	2
Vomiting	0	3	1	4
Gait disturbance	0	1	0	1
Incontinence	0	1	0	1
Memory disturbance	0	1	0	1
Hypersomnia	0	1	0	1

vegetative state in one. One patient with a tumor in the third ventricle presented a hypothalamic syndrome including adiposity and spells of hypersomnia. Many complaints were episodic or transient thus delaying the diagnosis in patients with lateral ventricular tumor. The tumors often grow slowly to a substantial size before they become symptomatic.

### Radiological findings

All patients had a preoperative MRI. Tumor size was ranged from 1.7cm to 9cm in diameter (average : 4.8cm). The tumors showed variable signal. Even though some neoplasms have characteristic MRI findings that may suggest the diagnosis, given the appropriate tumor location and age group<sup>6</sup>. MR signal intensity patterns were not helpful in predicting tumor histology in our cases. Hydrocephalus developed in three of six patients with the tumor in the lateral ventricle, in six of seven with the tumor in the third ventricle in one of two with the tumor in the fourth ventricle.

### Surgery and postoperative outcomes

Various surgical approaches were used. Decision of the surgical trajectory depends upon the careful analysis of imagings, particularly the arterial, venous anatomy and eloquent brain area. A transcortical approach was performed through the middle frontal gyrus or superior parietal lobule in eight patients. A transcallosal approach was done in four patients. A subfrontal trans-lamina terminalis approach was done in one. A suboccipital approach was performed in two patients. Of six patients with the tumor in the lateral ventricle, five had a transcortical approach and one had a transcallosal approach. In seven patients with the tumor in the third ventricle, tumor was resected via a transcallosal interforaminal approach in three, via a transcortical transforaminal approach in three and via

**Table 2.** Surgical approaches to variety of ventricular tumors and postoperative outcomes

	Tumor locations			Total
	Lateral	Third	Fourth	
Interhemispheric		GOS 3(1)		GOS 3(1)
transcallosal	GOS 5(1)	GOS 4(1)	(0)	GOS 4(1)
		GOS 5(1)		GOS 5(2)
Transcortical	GOS 4(1)	GOS 2(1)		GOS 2(1)
transventricular	GOS 5(4)	GOS 5(2)	(0)	GOS 4(1)
				GOS 5(6)
Subfrontal trans-lamina terminalis	(0)	GOS 1(1)	(0)	GOS 1(1)
Suboccipital	(0)	(0)	GOS 1(1)	GOS 1(1)
transvermian			GOS 4(1)	GOS 4(1)

GOS : Glasgow outcome scale, GOS 5 : good recovery, GOS 4 : moderate disability (disabled but independent), GOS 3 : severe disability (conscious but disabled), GOS 2 : persistent vegetative state, GOS 1 : death, (number) : no. of cases

a subfrontal approach in one. In patients with the tumor in the fourth ventricle, a suboccipital approach was performed (Table 2).

Gross-total resection was done in 12 patients, and subtotal resection in three patients. Extraventricular drainage of the cerebrospinal fluid was executed in eight of 10 patients with hydrocephalus before tumor mass removal. There, however, were no patients with ventriculo-peritoneal shunt for the treatment of the permanent hydrocephalus after surgery.

Surgical outcome was classified with Glasgow outcome Scale (GOS). It showed good recovery (GR) in eight (53%), moderate disability (MD) in three (20%), severe disability (SD) in one (7%), vegetative state (VS) in one (7%), death (D) in two (13%). Surgical outcome was relatively good in 11 patients with good recovery and moderate disability (73%) (Table 2). Surgical outcome was better by 4 and 5 points on the Glasgow outcome scale in patients with the tumors in the lateral ventricle, comparing to other groups. Out of five patients with deteriorated mental state before surgery, three showed poor outcome after surgery. Of these three patients, two patients died because of recurrence of the tumor and the other patient was in vegetative state. The histopathological diagnosis of the recurrent cases were atypical teratoid-rhabdoid tumor, pilocytic astrocytoma, and anaplastic astrocytoma.

### Histopathologic findings

The tumors in the lateral ventricle were central neurocytoma (2 cases), meningioma (2 cases), subependymal giant cell astrocytoma (1 case) and germinoma (1 case). The tumors in the third ventricle were chordoid astrocytoma (1 case), paraganglioma (1 case), pilocytic astrocytoma (1 case), metastatic tumor (1 case), germinoma (1 case), anaplastic astrocytoma (1 case), neuroepithelial cyst (1 case). The tumors in the fourth ventricle were primitive neuroectodermal tumor (1 case), atypical teratoid-rhabdoid tumor (1 case) (Table 4). It was difficult to find preferential site of the tumors occurred in the ventricle, because of short of patients for statistics.

**Table 3.** Postoperative complications

	Tumor locations			Total
	Lateral	Third	Fourth	
CSF leakage	1	0	0	1
Hemiparesis	1	1	0	2
Eye ball deviation	0	0	1	1
Ataxia	0	0	1	1
Dysarthria	1	0	1	2
Central diabetes insipidus	1	0	0	1
Ptosis	0	1	0	1
Gait disturbance	0	1	0	1
Meningitis	1	1	0	2
Subdural hygroma	0	1	0	1

**Table 4.** Histopathologic findings of the tumors

	Tumor locations			Total
	Lateral	Third	Fourth	
Meningioma	2	0	0	2
Germinoma	1	1	0	2
Central neurocytoma	2	0	0	2
Chordoid astrocytoma	0	1	0	1
Pilocytic astrocytoma	0	1	0	1
Anaplastic astrocytoma	0	1	0	1
Subependymal giant cell tumor	1	0	0	1
Primitive neuroectodermal tumor	0	0	1	1
Atypical teratoid-rhabdoid tumor	0	0	1	1
Metastatic tumor	0	1	0	1
Neuroepithelial cyst	0	1	0	1
Paraganglioma	0	1	0	1

### Complications

Postoperative complications included transient hemiparesis in two, transient dysarthria in one, meningitis in two, subdural hygroma in one, CSF leakage in one, truncal ataxia in one, central diabetes insipidus in one, ptosis in one, gait disturbance in one, and eye ball deviation in one (Table 3). All the neurologic complications were transient, which were recovered in three to nine months.

### Prognostic factors

Symptom duration, presentation of the hydrocephalus, extent of surgical resection of the tumor, approach methods, tumor size, tumor location, and tumor grade were analyzed for prognostic factor (Table 5). Even though it was not reliable

**Table 5.** Analysis of prognostic factors

	Number of patient	Good outcome (%)	Poor outcome (%)	P value
Symptom duration	15			
< 1 month	7	4 (57.1)	3 (42.9)	0.231
> 1 month	8	7 (87.5)	1 (12.5)	
Types of removal	15			
gross total resection	12	9 (75.0)	3 (25.0)	0.694
subtotal resection	3	2 (66.7)	1 (33.3)	
Preoperative	15			
present	10	8 (80.0)	2 (20.0)	0.425
absent	5	3 (60.0)	2 (40.0)	
Approaches	12			
transcortical	8	7 (87.5)	1 (12.5)	0.478
transcallosal	4	3 (75.0)	1 (25.0)	
Location	15			
lateral	6	6 (100.0)	0 (0.0)	0.084
third	7	4 (57.1)	3 (42.9)	
fourth	2	1 (50.0)	1 (50.0)	
Histologic grade	15			
high grade	4	2 (50.0)	2 (50.0)	0.155
low grade	11	9 (81.8)	2 (18.2)	

statistically due to small numbers of this study, it seemed that patients with symptom duration less than one month and high grade tumor showed poor prognosis. In contrary patients with the tumors in the lateral ventricle showed relatively good prognosis.

## Discussion

Intraventricular tumors are uncommon CNS masses, representing only 3% to 10% of all intracranial neoplasm<sup>8</sup>. Jelinek et al<sup>6</sup> insisted that classification of patient's ages, locations of the tumors, findings of computed tomography and magnetic resonance images could help the differential diagnosis of the variable kinds of the tumors of the lateral ventricle. But authors recognized the difficulties in differential diagnosis of the ventricular tumors only with MRI findings except two cases of meningioma in the trigone of the lateral ventricle. And it was difficult to find the predisposing locations of the ventricular tumors. It was probably due to small numbers of this study and variable pathology of tumors. Therefore, more extended study should be done for confirmative result.

Most of the clinical symptoms produced by tumors are related to increased intracranial pressure and direct pressure on the surrounding brain structures<sup>8,13</sup>. Intraventricular tumors are frequently benign or low grade<sup>11</sup>. The tumors often grow slowly to a substantial size before they become symptomatic, unless the lesion is located in a region where it interferes with CSF circulation early on<sup>8,13</sup>. Besides, seizure attack, motor and sensory disturbance, decreased visual field, voiding difficulty and gait disturbance can develop by pressure of the tumor on the brain parenchyma. In authors case, headache, consciousness change, and vomiting by increased intracranial pressure were the major clinical symptoms. Some patients showed visual field deficit, seizure attack, gait disturbance and memory disturbance. All patients with the tumors in the lateral ventricle showed chronic headache for several months, and patients with the tumors in the third ventricle revealed sudden loss of consciousness. The difference of the clinical presentation according to tumor location was reliable in statistics ( $p=0.012$ ). This result implied that the tumor in the third ventricle can easily develop obstruction of CSF pathway resulting in increment of intracranial pressure. In development of hydrocephalus, the tumor location is more important than the tumor size or pathological diagnosis<sup>7</sup>. In author's study, hydrocephalus was accompanied in 85% of patients with the tumor in the third ventricle, in 50% of patients with the tumor in the lateral ventricle, and in 50% of patients with the tumor in the fourth ventricle. The differences of development of hydrocephalus, however, was not reliable in statistics ( $p>0.05$ ).

The ventricular tumor represents an unusually wide variety

of pathologic entities. According to the study on the ventricular tumors in Japan, common histopathology were astrocytoma, ependymoma, choroid plexus papilloma, glioblastoma, oligodendroglioma, malignant astrocytoma, malignant lymphoma, mixed glioma, epidermoid, neurinoma in the lateral ventricle and craniopharyngioma, astrocytoma, germinoma, pituitary adenoma, malignant astrocytoma, glioblastoma, ependymoma, oligodendroglioma, malignant lymphoma, teratoma, pineoblastoma in the third ventricle<sup>10</sup>. Lee et al reported 41 cases of the ventricular tumors including medulloblastoma, meningioma, hemangioblastoma, anaplastic astrocytoma, oligodendroglioma, central neurocytoma, choroid plexus papilloma, cavernous hemangioma, giant cell astrocytoma, ependymoma, subependymoma, malignant lymphoma, and teratoma<sup>8</sup>. Author's cases were also variable in histopathology including central neurocytoma, germinoma, meningioma, subependymal giant cell astrocytoma, chordoid astrocytoma, paragonimiasis, pilocytic astrocytoma, metastatic tumor, anaplastic astrocytoma, primitive neuroectodermal tumor, atypical teratoid-rhabdoid tumor and neuroepithelial cyst. In histopathological study, four of 15 patients showed high grade tumor. The tumors was located in the third ventricle in two patient, and in the fourth ventricle in two cases. Even though it was not reliable in statistics ( $p>0.05$ ), the third and fourth ventricles were predisposing location of the high grade tumors.

Surgical planning to the tumors in the ventricle aims to find the best surgical corridor and to evaluate the anatomic structures of the region involved. And it is necessary to consider the tumor location and size, ventricle size, artery distribution, neurological abnormality, and the location of dominant cerebral hemisphere. Since Dandy<sup>3,4</sup> introduced the transcortical and transcallosal approaches to the third and lateral ventricular tumors in the 1930s, many neurosurgeons have described about various surgical approach so far.

In six patients with the tumors in the lateral ventricle, the tumor was resected successfully via transcortical approach in five, via transcallosal approach in one. In general, transcortical approach can be preferred for patients with ventriculomegaly<sup>11</sup>. Authors, however, could successfully resected the tumors in the frontal horn in two cases, and in the atrium in one case via transcortical approach, even though absence of ventriculomegaly. In patients with the tumor in the lateral ventricle extending to the corpus callosum and the contralateral lateral ventricle, subtotal removal was done in one patient via transcortical approach, and gross total removal was performed in one patient via transcallosal approach. Authors preferred transcallosal approach in patients with the tumors in the lateral ventricle extending contralaterally and superiorly to the ventricle. Even though many studies reported high incidence of postoperative seizure after transcortical approach<sup>1</sup>, authors could

avoided postoperative seizure after transcortical approach with small cortical incision and disuse of the retractors.

The tumors in the third ventricle were resected via transcortical transforaminal approach in three patients, via transcallosal interforaminal approach in three patients, and via subfrontal trans-lamina terminalis approach in one patient. The transcallosal approach devised by Dandy<sup>3)</sup> and advocated for the removal of ventricular tumors by Shucart, and Stein<sup>14)</sup> seems to offer several advantages. This route provides to surgeons more orienting anatomical landmarks than the transcortical approach in localizing intraventricular tumors<sup>11)</sup>. It does not require the removal of cortical tissue, can be used regardless of ventricular size, and seems not to have long-lasting neurological or behavioral sequelae<sup>1,2,16)</sup>, although Jeeves et al<sup>5)</sup> have found some impairment in the transfer of tactile information. Concentration should be done during transcallosal approach not to develop venous infarction or other serious neurologic sequelae due to injury of the sagittal sinus or the draining veins to the sagittal sinus. During the operation, authors did not use the retractors to protect the large cortical veins, especially draining into the sagittal sinus, so that authors could avoid postoperative venous infarction and other neurological complications. To reduce complication after callosotomy, callosal incision should be done in keeping with normal anatomy. It is also important to divide the corpus callosum exactly at the midline, to prevent damage to the indusium griseum. Furthermore, it must be aware of spatial orientation of the third ventricle due to probable distortion of the third ventricle.

The differences of postoperative outcome according to the approach methods were not seemed to be reliable statistically because of small numbers of the study group ( $p > 0.05$ ).

The two most common surgical approaches to the fourth ventricle are the transvermian and telovelar approaches<sup>9,12,15)</sup>. In author's cases, all the tumors in the fourth ventricle were resected via transvermian approach. Authors could successfully resect the tumors with minimal retraction of the vermis and avoid caudal vermian syndrome, even though transvermian approach has some limitation in approaching to the lateral recess. Authors could not evaluate the differences of postoperative outcome between several approach methods to the fourth ventricle due to use of one approach in this study.

In eight patients with preoperative hydrocephalus, authors performed the extraventricular drainage and it has been maintained for a couple of days postoperatively. For correction of pre- and postoperative hydrocephalus, shunt or extraventricular drainage could be done. Authors could minimize sustaining hydrocephalus with preoperative extraventricular drainage and maintenance of this drainage postoperatively. Shunt operation was not necessary in all patients. However, in patients with development of postoperative hydrocephalus, shunt operation

must be done.

As a whole, 73% of patients with tumors removal showed good postoperative outcome 73% (GOS 4, 5). Lee et al.<sup>8)</sup> reported a good postsurgical outcome of 75.6% in their series, and noted the factors related with poor outcome including sudden onset of the symptoms, preoperative hydrocephalus, partial resection of the tumor, postoperative intracranial hemorrhage, persistent hydrocephalus, and newly developed seizure after surgery. In our study, good surgical outcome was related with location of the tumor, particularly in the lateral ventricle. The factors related with poor prognosis were abrupt onset of symptoms and malignant histopathological findings. In case of malignant tumors, the prognosis was poor because there was quite probability of a recurrence of the tumors. In case of malignant tumors, it is considered close follow-up is necessary even though gross total removal.

We could not find any differences in prognosis by different approach. Each approach has its advantages and disadvantages. If we understand each surgical approach with thorough knowledge of surgical anatomy and its variation correctly, we can obtain successful surgical outcome without serious postoperative complications.

## Conclusion

The ventricular tumors have variable clinical presentations depending on their location and a variety of histopathologic findings. Postoperative outcome depended on the tumor location, symptom duration, presence of hydrocephalus, pathology of the tumor, even though a lack of statistic reliability. There was no difference in outcome according to the approach method to the tumors. And it was necessary to be aware of various approach methods to the tumors and anatomy surrounding the ventricle for avoidance of neurological complications.

And it is necessary to accumulate the numbers of the case for statistic reliability through further study.

## References

1. Actunes JL, Louis KM, Ganti SR : Colloid Cysts of the third ventricle. *Neurosurgery* 7 : 450-455, 1980
2. Apuzzo MLJ, Chikovani OK, Gott PS, Teng EL, Zee C-S, Giannotta SL, et al : Transcallosal, interforaminal approaches for lesions affecting the third ventricle : Surgical considerations and consequences. *Neurosurgery* 10 : 547-554, 1982
3. Dandy WE : *Benign Tumors in the Third Ventricles of the Brain : Diagnosis and Treatment*. Springfield : Charles C Thomas, 1933
4. Dandy WE : *Benign Encapsulated Tumors in the Lateral Ventricle of the Brain : Diagnosis and Treatment*. Baltimore : Williams & Wilkins, 1934
5. Jeeves MA, Simpson DA, Geffen G : Functional consequences of the transcallosal removal of intraventricular tumours. *J Nurol Neurosurg Psychiatry* 42 : 134-142, 1979
6. Jelinek J, Smirniotopoulos JG, Parisi JE, Kanzer M : Lateral ventricular neoplasms of the brain : Differential diagnosis based on clinical, CT, and MR findings. *Am J Roentgenol* 155 : 365-372, 1990

7. Lapras C, Deruty R, Bret PH : **Tumors of lateral ventricles : Advances and technical standards in neurosurgery** Vol. 11. Edited by Simon L, et al, Springer Verlag, 103-167, 1984
8. Lee JH, Ko Y, Bak KH, Kim YS, Kim JM, Kim CH, et al : Surgical outcome and complications of intraventricular tumors. *J Korean Neurosurg Soc* 27 : 763-769, 1998
9. Matsushima T, Fukui M, Inoue T, Natori Y, Baba T, Fujii K : Microsurgical and magnetic resonance imaging anatomy of the cerebellomedullary fissure and its application during fourth ventricle surgery. *Neurosurgery* 30 : 325-330, 1992
10. Miki T, Wada J, Nakajima N, Haraoka J : Neuroendoscopic surgery for ventricular tumors. *No To Shinkei* 55 : 479-486, 2003
11. Morita A, Kelly PJ : Resection of Intraventricular Tumors via a Computer-assisted Volumetric Stereotactic Approach. *Neurosurgery* 32 : 920-927, 1993
12. Mussi ACM, Rhoton AL Jr : Telovelar approach to the fourth ventricle : microsurgical anatomy. *J Neurosurg* 92 : 812-823, 2000
13. Nakamura M, Roser F, Bundschuh O, Vorkapic P, Samii M : Intraventricular Meningiomas : A Review of 16 cases with reference to the literature. *Surg Neurol* 59 : 491-504, 2003
14. Shucart WA, Stein BM : Transcallosal approach to the anterior ventricular system. *Neurosurgery* 3 : 339-343, 1978
15. Tanrinover N, Ulm AJ, Rhoton AL Jr, Yasuda A : Comparison of the transvermian and telovelar approaches to the fourth ventricle. *J Neurosurg* 101 : 484-498, 2004
16. Woiciechowsky C, Vogel S, Lehmann R, Staudt J : Transcallosal Removal of Lesions Affecting the Third Ventricle : An Anatomic and Clinical Study. *Neurosurgery* 36 : 117-123, 1995

## Commentary

The authors retrospectively reviewed 15 patients presenting between 1998 and 2003 with intraventricular tumors. The purpose of this article was to evaluate the clinico-radiopathological features and analyze outcome and complication according to various predictive factors including location of tumors, approach methods, degree of resection, and so on. Despite limitation of very small number of cases, the favorable outcome after operation with various corridors corresponded to other series.

Our institutional strategy for removal of intraventricular tumors could be summarized as follows. For the lateral ventricle

tumors located on frontal horn or body, we use the interhemispheric transcallosal or transcortical approach. Using frameless neuronavigation system, we can safely approach through the desired point of entry into the lateral ventricle or the foramen of Monro and select the point of entry into the corpus callosum when approaching intraventricular tumors by the transcallosal approach. We prefer the transtemporal approach in patients with temporal horn or trigone lesions. We have often used posterior middle temporal gyrus incision, especially on the dominant hemisphere, to avoid language complications and at the same time afford an excellent visualization of tumor and its blood supply. If the trigone lesion extends superiorly, we prefer the superior parietal lobule approach. For the third ventricle tumors, especially in craniopharyngiomas, we prefer the subfrontal trans-lamina terminalis or interhemispheric transcallosal approach. In complex case, combined approach can be considered. For the fourth ventricle tumors, midline suboccipital approach is generally used. We think that the selection of the surgical approach for intraventricular tumors should be made on a case-by-case basis in light of many considerations, such as tumoral origin and peritumoral anatomical obstacles, growth pattern and possible postoperative complications, and so on. Furthermore, we consider that it can be a safe and advantageous way to use of intracranial navigation as guidance to the point of entry into the ventricle and toward the tumor.

The authors have conscientiously reviewed the intraventricular tumors in a view of clinical findings, diagnostic investigation, pathological findings, surgical approaches, and the results. This paper gives a summarized look on intraventricular tumors.

Sam-Suk Kang, M.D.  
Chonnam National University Hospital,  
Medical School