Intraventricular Meningiomas
A Review of the Literature and Report of 8 Cases
Tahsin Erman, MD,* A. İskender Göçer, MD,* Şeyda Erdoğan, MD,† Bülent Boyar, MD,* Sebahattin Hacıyakupoğlu, MD,* and Suzan Zorludemir, MD†

Abstract: Intraventricular meningiomas are rare tumors, comprising only 0.5% to 5% of all intracranial meningiomas. In this article, 8 cases of histopathologically proven intraventricular meningioma that were treated at the Çukurova University Neurosurgery Department are discussed. The radiologic, histologic, and clinical findings of intraventricular meningiomas and the surgical approach to lateral intraventricular meningiomas were reviewed retrospectively. Our 8 patients ranged in age from 18 to 65 years (mean = 44.6 years). Two patients were male and 6 were female, for a 1:3 male-to-female ratio. Computed tomography and magnetic resonance imaging demonstrated the 7 tumors within the lateral ventricle and only 1 tumor within the third ventricle. All lateral ventricular tumors were located in the region of the trigone. Headache and hemiparesis were the most common presenting symptoms. Histologic studies revealed meningotheliomatous meningiomas in 5 patients, transitional meningioma in 2 patients, and anaplastic (malignant) meningioma in 1 patient. The superior parieto-occipital approach in 5 patients, posterior middle temporal gyrus approach in 2 patients, and posterior transcallosal approach in 1 patient were used for surgical therapy, and total resection was achieved in all patients. The overall neurologic outcome at follow-up (mean follow-up = 12 months, range: 1 month to 5 years) was excellent (no deficit) in 4 patients, good (some deficit but independent) in 2 patients, and poor (dependent) in 1 patient. One patient died after surgery. We conclude that intraventricular meningiomas are curable by complete surgical resection. This is possible with little neurologic morbidity when the neurosurgeon understands the surgical approaches available and the indications for those approaches.

Key Words: intraventricular, meningioma, surgery, tumor, ventricle

Intraventricular neoplasms are uncommon central nervous system (CNS) masses, representing only 10% of all neoplasms.¹ Meningiomas account for 10% to 15% of all intracranial tumors.²⁻⁶ The incidence of intraventricular meningiomas among other intraventricular tumors varies from 20% to 30%.⁷ They generally arise within the lateral ventricles and, more rarely, in the third and fourth ventricles.¹⁻¹⁰

Between 1995 and 2003, 201 consecutive patients with intracranial meningiomas were operated on at Çukurova University School of Medicine, Adana, Turkey. The present study involves 8 patients with histopathologically proven intraventricular meningiomas. The radiologic, histologic, and clinical finding of these tumors and the surgical approach to lateral intraventricular meningiomas were reviewed retrospectively.

MATERIALS AND METHODS
The tumors were evaluated with computerized tomography (CT), magnetic resonance imaging (MRI), magnetic resonance angiography (MRA), and digital subtraction angiography (DSA). Tumors were considered to be within the ventricle only if radiologic studies showed that the lesion was predominantly intraventricular with minimal extraventricular extent or that the lesion arose from within the ventricle. Radiologic, histologic, and clinical data and surgical approaches in these cases were reviewed retrospectively.

SUMMARY OF CASES
Age and Sex Distribution
The 8 patients included in this study ranged in age from 18 to 65 years (mean = 44.6 years). Two patients were male and 6 were female, for a 1:3 male-to-female ratio.

Localization of the Lesion
In 7 of the 8 patients (87.5%), the meningiomas were located within the lateral ventricle, and in 1 patient (12.5%), the tumor was located in the third ventricle. All lateral intraventricular meningiomas were located in the trigone of the lateral ventricle, and in 5 of the 8 patients (62.5%), the meningiomas were located in the left lateral ventricle.

Symptoms and Signs
The presenting symptoms of the patients in our series were nonspecific. Headache was seen in 6 patients (75.0%).
Hemiparesis was seen in 3 patients (37.5%). Visual involvement, vomiting, and seizure were seen in 2 patients (25.0%). Seizure was seen in 1 patient (12.5%). Headache and hemiparesis were the most common presenting symptoms. Clinical findings are summarized in Table 1.

**Diagnosis**

**CT**

Three patients underwent cerebral CT. In 2 of the 3 patients, an isodense well-defined mass in the lateral ventricle with central and peripheral calcification was shown on the noncontrast-enhanced CT (Fig. 1). After administration of contrast material, a homogeneous contrast-enhancing solid mass within the lateral ventricle was seen in all patients.

**MRI**

Seven patients underwent cerebral MRI. In 6 of the 7 patients, MRI revealed isointensity and slight hypointensity to gray matter on the T1-weighted images, hyperintensity to gray matter on the T2-weighted images, and an intense and homogeneous contrast-enhancing solid lesion located within the trigone of the lateral ventricle (Figs. 2–4). In case 3, a hypointense signal was seen in the center of the tumor on T1-weighted images after gadolinium injection (Fig. 5). In case 6, MRI demonstrated a slight hypointensity to gray matter on the T1-weighted images and an intense and homogeneous contrast-enhancing solid lesion located within the third ventricle; extension of the mass into the lateral ventricle was also revealed.

**MRA**

Two patients underwent MRA, which revealed an enlarged anterior choroidal artery.

**DSA**

Four patients underwent carotid and vertebral angiography. Three of these patients displayed an enlargement of the anterior choroidal artery and vascular blushing in the region of the internal carotid artery and/or anterior cerebral arteries. Two patients had vascular blushing in the region of the posterior cerebral arteries. One patient had an aneurysm of the anterior choroidal artery.

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**TABLE 1. Findings in 8 Patients With Intraventricular Meningiomas**

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/sex (y)</th>
<th>Presenting Symptoms</th>
<th>Histology</th>
<th>Localization in Ventricle</th>
<th>Surgery</th>
<th>Postoperative Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18/F</td>
<td>Headache, visual changes</td>
<td>Transitional meningioma</td>
<td>Left lateral ventricle-trigone</td>
<td>Transcortical (posterior middle temporal gyrus)</td>
<td>Seizure</td>
</tr>
<tr>
<td>2</td>
<td>63/F</td>
<td>Headache, hemiparesis</td>
<td>Meningotheliomatous meningioma</td>
<td>Right lateral ventricle-trigone</td>
<td>Transcortical (superior parieto-occipital)</td>
<td>Subdural hygroma, homonymous hemianopsia</td>
</tr>
<tr>
<td>3</td>
<td>65/M</td>
<td>Headache, grand mal seizure</td>
<td>Malignant meningioma</td>
<td>Left lateral ventricle-trigone</td>
<td>Transcortical (superior parieto-occipital)</td>
<td>Death (intracerebral hemorrhage)</td>
</tr>
<tr>
<td>4</td>
<td>49/F</td>
<td>Hemiparesis, memory loss</td>
<td>Transitional meningioma</td>
<td>Left lateral ventricle-trigone</td>
<td>Transcortical (superior parieto-occipital)</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>40/F</td>
<td>Headache, aphasia, hemiparesis</td>
<td>Meningotheliomatous meningioma</td>
<td>Left lateral ventricle-trigone</td>
<td>Transcortical (superior parieto-occipital)</td>
<td>Seizure</td>
</tr>
<tr>
<td>6</td>
<td>37/F</td>
<td>Headache, nausea, vomiting</td>
<td>Meningotheliomatous meningioma</td>
<td>Third ventricle</td>
<td>Transcortical (superior parieto-occipital)</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>41/F</td>
<td>Visual changes, grand mal seizure</td>
<td>Meningotheliomatous meningioma</td>
<td>Left lateral ventricle-trigone</td>
<td>Transcortical (posterior middle temporal gyrus)</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>44/M</td>
<td>Headache, vomiting, dysphasia</td>
<td>Meningotheliomatous meningioma</td>
<td>Right lateral ventricle-trigone</td>
<td>Posterior Transcallosal</td>
<td>Left hemiparesis</td>
</tr>
</tbody>
</table>

F indicates female; M, male.
the tumor. The other patient demonstrated an enlargement of the posterior choroidal artery and marked shifting of the internal cerebral vein away from the side of the tumor as well as displacement of the lateral posterior choroidal artery on the side of the lesion.

Surgery

We used the superior parieto-occipital approach in 5 patients, posterior middle temporal gyrus approach in 2 patients, and posterior transcallosal approach in 1 patient. The total surgical excision was complete in all patients.

Postoperative Results

One week after surgery, 4 patients showed improvement of their neurologic symptoms and signs, and 2 patients were unchanged. Two patients had worsened, and 1 of these patients died of postoperative intracerebral hemorrhage 2 days after surgery. Postoperative seizures were seen in 2 patients (28.5%) after transcortical approaches and were controlled with phenytoin. Postoperative homonymous hemianopsia occurred in 1 patient (20.0%) after the superior parieto-occipital approach. Hemiparesis and subdural hygroma were seen in 1 patient. Complications are specified in Table 1.
The overall neurologic outcome at follow-up (mean follow-up = 12 months, range: 1 month to 5 years) was excellent (no deficit) in 4 patients, good (some deficit but independent) in 2 patients, and poor (dependent) in 1 patient, and residue or recurrence was not seen.

Histopathology
Multiple blocks from the resection materials were fixed in formalin, embedded in paraffin, sectioned, and stained with hematoxylin and eosin. Microscopic examination revealed meningotheliomatous meningiomas in 5 patients, which showed cellular whorls with delicate round or oval nuclei, inconspicuous nucleoli, and eosinophilic cytoplasm (Fig. 6). The histologic diagnosis in 2 cases was transitional meningioma. Microscopically, these tumors were rich in compact cellular whorls. There was no mitotic activity or necrosis. Finally, malignant meningioma with architectural disarray, high mitotic activity (20/10 high-power fields [HPFs]), necrosis, and cytologic atypism was identified in 1 case (Fig. 7).

DISCUSSION
Intraventricular meningiomas are rare lesions and account for approximately 0.5% to 5% of all intracranial meningiomas.2–6,11–16 The intraventricular location of meningiomas is impressively higher in childhood and adolescence than in adulthood. Although meningiomas constitute only 1% to 4% of all intracranial tumors, an intraventricular location was found in 9.4% to 22% of children.5–7,12,13,17–23 In our clinic, intraventricular meningiomas accounted for 3.9% of all intracranial meningiomas, and all of them were seen in adult patients. Intraventricular meningiomas are also more common in female subjects, exhibiting a female-to-male ratio of 2:19,10 or even higher in some series such as ours (3:1 ratio).7,17,19,21,24,25
An age predominance was not seen in our series.

Intraventricular meningiomas usually occur in the lateral ventricles but can occur anywhere in the ventricular system. The lateral ventricle is the most common location in adults, as in our series, whereas the third or fourth ventricle is the most common location in children.1,2,8,11,15,16 The incidence of meningiomas within the lateral ventricle varies from 0.5%17 to 4.5%18 of all meningiomas. Intraventricular meningiomas usually arise in the trigone of the lateral ventricle,1,2,19 and 12.0% of intraventricular meningiomas originate from the area of the foramen of Monro.20 In our series, 87.5% were located within the lateral ventricle, and all lateral intraventricular meningiomas were located in the region of the trigone. In 1 case (12.5%), the tumor, which originated mainly from the inferior
edge of the foramen of Monro, had grown into the third ventricle. Intraventricular meningiomas have been described as more common on the left side. 7–9 This preponderance has been confirmed in many reports, 18,21,22 although no substantial difference was seen in others. 7,17 In one series, the tumors occurred more frequently on the right side. 19 The meningiomas in our study showed a slight predilection for the left side, a finding that is in agreement with other reports in the literature. 8,9,17,18,21,22,23

The intraventricular localization and slow-growing pattern of the meningiomas provide a compensatory mechanism in the form of reserve space, which contributes to the delay in clinical demonstration of symptoms and signs. The most common presenting symptoms of an intraventricular meningioma are not related to the location of the tumor but rather to elevated intracranial pressure from an entrapped ventricle. In our patients, presenting symptoms of meningioma of the lateral ventricle were nonspecific, and headache and hemiparesis were the most common symptoms, a result in agreement with other reviews. 5–9,17,21,23,24 Visual field deficit and vomiting were significantly less common in our series than in other reviews. 6,17,18,21,23 The frequency of visual field deficit is important because its presence has some bearing on the choice of surgical approach. The incidence of visual involvement varied from 40% to 70% in several series. 17,18,21 Visual involvement was seen in 25% of the cases in our series. Seizures are rare. 9 In our series, grand mal seizure was seen in only 1 patient (12.5%), and dysphasia, alexia, and ataxia were not seen. Third ventricular meningiomas may cause signs and symptoms distinct from those of lateral intraventricular meningiomas. Anteriorly located lesions can cause memory deficits and endocrine abnormalities. Posteriorly located lesions are frequently present with Parinaud syndrome because of compression of the tectal plate. These findings were not seen in our patients, who presented with headache, nausea, and vomiting.

Intraventricular meningiomas arise from the connective tissue of the villi or from the stroma or arachnoid of the choroid plexus itself, which is abundant in arachnoidea. 11,16,23 This arachnoidal tissue is carried along with the choroid plexus as the ventricular system invaginates. 6,23 The occurrence of intraventricular meningioma depends on the presence of this structure, most often in the ventricular trigone, less commonly in the atrium and temporal horn, 6,12,26 and extremely rarely in the third and fourth ventricles. 6,7 Other investigators believe that intraventricular meningiomas are derived directly and arise from the same cell layer as the meninges. 11,23 A review of the histologic descriptions of 50 intraventricular meningiomas by Abbott and Courville 27 showed that these tumors are predominantly fibrous, fibroblastic, or psammomatous, with the exception of 1 angioblastic meningioma. A smaller series of 10 intraventricular meningiomas by Cruisado and Symon 24 had a somewhat different distribution of histologic types; there were 5 meningothelialiomatous lesions, 3 angiomatous lesions, 1 fibroblastic lesion, and 1 malignant lesion. Our cases were meningothelialiomatous lesions in 5 cases (62.5%), transitional meningioma in 2 cases (25.0%), and anaplastic (malignant) meningioma in 1 case (12.5%).

There are a variety of tumors that arise within the lateral ventricles, and most of them are benign or slow growing. 8 In spite of the development of modern imaging modalities, we still witness delays in diagnosis because of the relatively asymptomatic course of illness. CT and MRI are most useful in detecting these masses, and MRA and DSA have also proved to be of great value in demonstrating the vascular supply of the tumor. CT was more effective than MRI in the demonstration of calcifications, whereas MRI proved to be superior in the delineation of the tumor and its relation to surrounding structures. 6,10,28 Calcification visible on a CT scan was present in 47% of the meningiomas in a large series of intraventricular neoplasms. 19 In our series, 3 patients underwent cerebral CT, and 2 calcifications were seen. Meningiomas are characteristically hypointense to isointense on T1-weighted images and isointense to hyperintense on T2-weighted images, and the tumor uniformly enhances after contrast administration on MRI as in our cases. Trigonal tumors are homogeneous and are associated with localized dilation of the lateral ventricle, enlargement of the choroidal arteries, and engulfment of the choroid plexus. 1,6,7,16 Paratrigonal tumors displace the choroid plexus and compress the lateral ventricles, shifting the midline to the contralateral side. A heterogeneous signal caused by necrotic tissue, which is frequently emitted on both T1- and T2-weighted sequences, is suggestive of an aggressive type of meningioma as in our case 3 (Fig. 5).

MRA provides invaluable information regarding the arterial supply of the lesion and the venous drainage of the tumor and shows the anterior choroidal artery entering the mass. 4 DSA retains its value for 2 reasons: it shows the vascularity of the tumor itself, which is often an important diagnostic feature, and it allows the neurosurgeon to see the surrounding vascular anatomy. 6,7,10,24 Couillard et al 41 reported that MRA might be useful for planning surgery without the need for DSA. DSA was used in 4 of our cases and MRA was used in 2 for planning surgery. An enlargement of the anterior and posterior choroidal artery and vascular blush in the region of the tumor are common angiographic findings, as in our cases. 6,7,10,21,23,24

Important features for differential diagnosis include the age of the patient, the tumor’s location within the lateral ventricle, and density on CT or MRI before intravenous administration of contrast material. 1,10 All intraventricular tumor types (except subependymoma) show contrast enhancement. 1 Benign tumors were distinguishable from malignant tumors by their smooth margins. Intraventricular meningiomas should be particularly distinguished from choroid plexus papillomas. Choroid plexus papillomas commonly occur in infants and children, appear as well-circumscribed and densely enhancing masses within the trigone, and are associated with the choroid.
plexus. Their frond-like projections and associated hydrocephalus are characteristic. Frond-like projections are not seen in lateral intraventricular meningiomas. Any hydrocephalus that occurs in meningiomas is usually localized to the ipsilateral ventricle, whereas choroid plexus papillomas cause all the ventricles to enlarge. Localized ventricle enlargement of the lateral ventricle was not seen in our cases, however.

Intraventricular meningiomas are relatively resistant to most forms of therapy other than surgical excision, and their total removal often results in cure or provides a long period of palliation. Effective surgical intervention, however, is difficult, and the risks of surgery remain high, because intraventricular meningiomas are relatively infrequent tumors and most neurosurgeons do not have vast experience with them. Surgical resection is possible with low morbidity when the meningioma is confined to the ventricle and is not destroying the surrounding parenchyma. Their deep location in the cerebral hemisphere and the anatomy of the blood supply make their removal technically challenging, because the surgeon invariably has to violate normal neural tissue to gain access to the lesion. In a recent review of the subject, Piepmeier et al summarized the basic principles to follow in the resection of such lesions: early access to the blood supply, minimal retraction, piecemeal resection, and understanding of the functions of the surrounding structures. These factors must be borne in mind when the surgical approach is selected.

The posterior middle temporal gyrus approach, superior parieto-occipital approach, and posterior transcallosal approach may be used for meningiomas of the ventricular trigone. We used the superior parieto-occipital approach in 5 patients, the posterior middle temporal gyrus approach in 2 patients, and the posterior transcallosal approach in 1 patient. The problem of the surgical approach is simplified if the covering brain layer is thin. Incisions made directly over the tumor may minimize the depth transgressed, particularly with extremely large meningiomas. This direct approach has been used by a number of surgeons. Fornari et al recommend the parieto-occipital sagittal paramedian route, which, in their experience, seems to be the safest, securing the optic radiations (which lie inferolaterally to the ventricles) and never contributing to severe speech or motor deficits. Criticisms of the superior parieto-occipital approach are late identification of feeding arteries to the tumor and potential injury to the optic radiations. Postoperative visual deficits can be avoided by entering the ventricle superiorly and avoiding the optic radiations inferior and lateral to the ventricle, and feeding arteries can be easily controlled by first debulking the tumor and then reflecting the capsule to expose the feeding arteries. A high cortical incision may be used for dominant hemisphere lesions to avoid speech disturbances. Relative contraindications to this route may be the presence of a right homonymous hemianopsia; in these cases, a temporal or parietal incision would be justifiable. Frameless stereotaxy is valuable in selecting a trajectory to the superior-lateral aspect of the lateral ventricle, thus avoiding the optic radiations. Morita and Kelly also suggested the use of a computer-assisted volumetric stereotactic technique and reported that tumor could be removed by means of this technique with a safe trajectory that avoids important cortex, subcortical pathways, and vital vessels, even in patients with small ventricles. Postoperative visual field deficit is reported, with an incidence of between 20% and 60%. When visual loss occurs, this is usually a result of homonymous hemianopsia. Postoperative homonymous hemianopsia occurred in 1 patient (20.0%) in our series.

In contrast, the posterior middle temporal gyrus approach has the advantage of direct access to the ventricular trigone through the temporal horn of the lateral ventricle and early exposure of the anterior choroidal artery. The posterior middle temporal gyrus approach causes less damage to the visual projection fibers, because the incision is parallel to them. Language function may be compromised, however. Auditory comprehension deficits may also occur if damage is incurred in the posterior superior temporal or supramarginal region because of retraction or manipulation. This approach is also facilitated if the temporal horn is dilated. This approach has several limitations, however. Large intraventricular meningiomas with a major extension into the occipital horn can be difficult to resect by this approach, especially if the tumor capsule is adherent to the ependyma posteriorly. Damage to the visual pathway fibers can cause a homonymous visual field cut. This can be minimized by making the cortical and white matter incision in a direction parallel to the fibers. Language function in the dominant hemisphere can also be compromised, because the location of the speech cortex varies and speech representation may extend into the posterior medial temporal lobe. Couillard et al suggested a combination of the transtemporal and transparietal approaches and the use of intraoperative ultrasound and balloon dilation of operative corridors, particularly for improvement of the postoperative visual field deficit.

The transcallosal approach of Kempe and Blaylock has many theoretical advantages. Posterior callosotomy provides excellent exposure to the ventricular trigone and posterior third ventricle. The incidence of postoperative seizures should be lower. Speech and visual disturbances should not result, and expeditious access to the posterior choroidal artery is possible. Unfavorable results, complications, and the fear of creating a disconnection syndrome are significant deterrents to this approach, however. Callosotomies greater than 2.5 cm in length or in the posterior corpus callosum may result in a disconnection syndrome. Jin and Nutik also recommend the transcallosal approach, but the transcallosal route is not suitable for paratrigonal tumors in their opinion. This approach is contraindicated in patients with a right homonymous hemi-
anopsia, because sectioning of the splenium of the corpus callosum in this circumstance results in alexia without agraphia.9,33

The superior parieto-occipital approach is advantageous in our opinion, but transcortical approaches greatly increase the chance of seizures in contrast to the transcalsallosal route.4,7,8,28 Kempe and Blaylock22 reported a 29% rate of postoperative seizure in their series. Postoperative seizures were seen in 2 patients (28.5%) in our series and were controlled with phenytoin.

Preoperative embolization is not practical to reduce the blood supply to an intraventricular meningioma, because the small terminal arteries are difficult to catheterize.9 This is the reason why we did not use preoperative embolization.

Detection of asymptomatic meningiomas is increasing as a result of diagnostic advances, including CT and MRI. Other possible treatments for this incidentally discovered intraventricular meningioma include medication (hormonal),34 the gamma knife, and/or embolization.35,36 although the efficacy of these treatments has not been established and there have been few reports on them to date. The gamma knife is said to control the growth of meningiomas less than 35 mm in diameter. Lunsford36 reported a 4-year actuarial control rate for benign meningiomas of 92%. Embolization and gamma knife therapy may be alternative treatments of intraventricular meningioma in which surgical resection appears difficult.

Radiotherapy is effective for preventing recurrence in partially resected meningiomas and malignant meningiomas.35–37 Radiotherapy was not used in our cases, because the total removal of tumors was achieved in all cases. In case 3, malignant meningioma was seen, but the patient died during the early postoperative period.

CONCLUSION

Intraventricular meningiomas are curable by complete surgical resection. This is possible with little neurologic morbidity when the neurosurgeon understands the surgical approaches available and the indications for these approaches.

REFERENCES