Choroid plexus cyst and chordoid glioma

Report of two cases

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Several types of mass lesions may occur in the third and lateral ventricles. Typically they arise from the lining of the ventricular cavity or from contiguous structures, by extension into the ventricle. The authors describe two patients, each of whom presented with a different rare lesion of the ventricular system. The first was a 53-year-old woman with a history of hypertension who sustained a blunt traumatic injury to the occipital region and subsequently developed a progressively worsening right-sided headache. Radiological examinations over the next 2 years revealed an enlarged right lateral ventricle and, ultimately, a choroid plexus cyst in its anterior and middle third, near the foramen of Monro, which is a rare location for these lesions. The cyst was removed en bloc, and follow-up examinations showed a significant improvement in her headache and a minimal differences in size between right and left ventricles. The authors also describe a 57-year-old man with hypertension, diabetes mellitus, and an old mycardial infarct, who presented to an outside institution with a progressively worsening headache, generalized malaise, and loss of olfactory sensation. Diagnostic imaging revealed a 1.5-cm oval lesion centered in the lamina terminalis region, an open craniotomy was performed, and evaluation of a biopsy sample demonstrated the mass to be a chordoid glioma of the third ventricle, a recently described glioma subtype. Two days after surgery, he suffered a left parietal stroke and an anterior mycardial infarction. After convalescing, he presented to The University of Texas M. D. Anderson Cancer Center for radiotherapy and follow up; 7 months later he was readmitted complaining of headache, short-term memory loss, and worsening confusion and disorientation. Neuroimaging revealed progression of the tumor (now 2 cm in diameter), which was removed by gross-total resection. His headache resolved immediately, and 2 months later his only complaint was of episodes of confusion. Three weeks later he died of a massive myocardial infarction. These two patients represent the sixth case of an adult with a choroid plexus cyst in the anterior lateral ventricle and the 19th case of an adult with a chordoid glioma of the third ventricle, respectively.

KEY WORDS • intraventricular tumor • cyst • choroid plexus • chordoid glioma • transcallosal approach

A variety of mass lesions may occupy the third and lateral ventricles. They usually arise from the coverings of the ventricular wall or extend into the ventricle from contiguous areas in the basal ganglia, thalamus, hypothalamus, suprasellar, and pineal regions.[7] Pilocytic astrocytomas, ependymomas, colloid cysts, pineal parenchymal tumors, and craniopharyngiomas are frequently found here. We describe the cases of two adult patients who harbored rare lesions of the ventricular system. In one patient a choroid plexus cyst was present in the anterior and middle third of the right lateral ventricle near the foramen of Monro, which is a rare site for such lesions. In the second patient a chordoid glioma, a recently described glioma subtype, was located in the third ventricle. After a description of each case, a discussion of each entity is separately provided and a video presentation of their respective surgeries is also included.

CASE REPORT

Choroid Plexus Cyst

Presentation and Examination. This patient was a 53-year-old Caucasian, right-handed woman with a history significant for medication-controlled hypertension. In November 1998, she fell off a stool and sustained a blunt traumatic injury to the occipital region. This was not associated with loss of consciousness. Subsequently, the patient developed a progressive headache, which she described as a constant pressure sensation always on the right side, and occasionally progressing to involve the whole head. It was not related to postural changes. A CT study and MR imaging study of the head revealed that the

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right lateral ventricle was mildly larger than the left lateral ventricle, but there was no evidence of mass lesions. This was considered a congenital anomaly, and the patient was managed conservatively with analgesic medications. Meanwhile, the headache progressively worsened. A repeated MR image study of the brain obtained in July 1999 demonstrated further discrepancy in size between the right and left lateral ventricles, but no mass lesion was noted.

In April 2000, the patient presented to our clinic at M.D. Anderson where MR imaging of the brain revealed a well-circumscribed small cystic mass, 7 mm in diameter, with signal intensity similar to CSF, along the foramen of Monro on the right side and with associated unilateral right-sided hydrocephalus that caused bowing of the septum pellucidum to the left (Fig. 1). The patient reported that over the last few months her headache was significantly worse and was associated short-term memory loss, nausea, dizziness, and unbalanced gait. Results of her physical examination were essentially normal.

Operation. Transcallosal surgery via a right frontal craniotomy was performed after induction of endotracheal anesthesia. Intraoperative ultrasonography and the Surgiscope (Dee Med, Grenoble, France), an MR image-guided surgical navigation microscope, were used for guidance. The well-circumscribed cystic lesion was readily identified within the right lateral ventricle and observed to be obstructing the inflow of CSF through the foramen of Monro. This lesion was intimately attached to the septal vein and was carefully dissected off this structure. The cyst was removed en bloc. It was filled with clear fluid. (Video Clip 1)

Click here to view Video Clip 1.

Histological Examination. Microscopic examination showed a benign cyst composed of low cuboidal epithelium that was morphologically identical to choroid plexus epithelium. The choroidal origin of the epithelium was confirmed by demonstrating immunopositivity for transthyretin (prealbumin), which is a marker for choroid plexus epithelium. The cyst lining was negative for epithelial membrane antigen, which would be positive were the lesion an arachnoid cyst, and also negative for mucin (mucicarmine stain), which would be positive if the lesion were a colloid cyst of the third ventricle (Fig. 2).
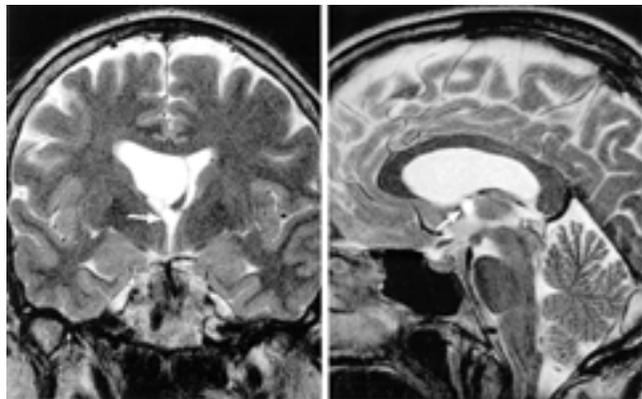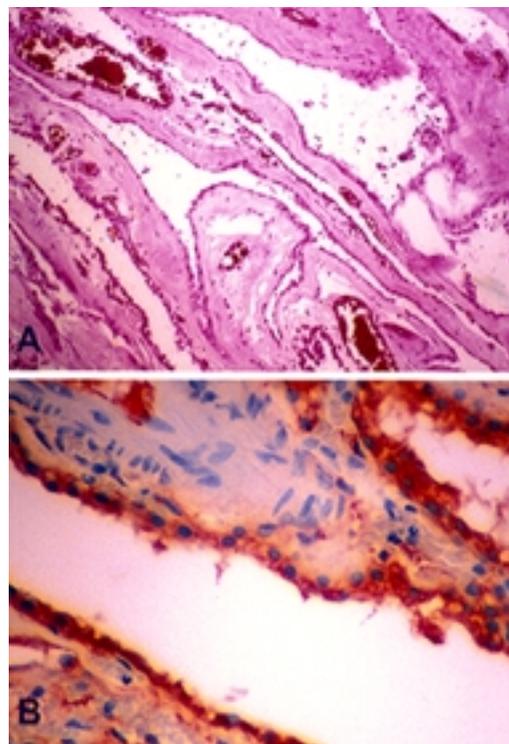

Fig. 2. Case 1. Photomicrographs. A: Staining of the cyst lining shows a low cuboidal epithelium with a subjacent collagenous wall. The morphological features of the epithelium, including the presence of a single large cytoplasmic vacuole in some cells, is consistent with choroid epithelium. H & E, original magnification × 200. B: Immunohistochemistry performed for transthyretin (prealbumin) showing strong positivity in the epithelial cells lining the cyst. Original magnification × 200.

Postoperative Course. The patient's postoperative course was uneventful, and she was discharged home 4 days later. Her headache significantly improved on follow-up visits. Postoperative MR imaging demonstrated total resection of the ventricular cyst, and minimal difference in size between the right and left ventricular size was apparent.

Discussion

Netsky and Shuangshoti[15] have reported cysts of the choroid plexus in 38% of the telencephalic choroid plexuses in their 124 autopsy cases. Small choroid plexus cysts are usually asymptomatic and are usually incidentally encountered at autopsy. They are generally less than 1 cm in diameter and do not cause obstructive symptoms. Larger cysts, which can measure up to 7 cm in diameter, may produce symptoms secondary to ventricular dilation or outlet obstruction. They are most frequently found in children and account for approximately 3% of all pediatric cerebral pathological entities.[2,17,19] These cysts are congenital and may occur in any ventricular cavity. They can be uni- or bilateral, single or multiple.[1,2, 11,12,18] In the lateral ventricle, they usually congregate at and around the trigone.[9,14,17] Cysts localized in the anterior part of the lateral ventricles are very rare.[18] To date, only five cases of choroid plexus cyst have been described in this location, and the present study adds a sixth example of such an enti-

Fig. 1. Coronal *(left)* and sagittal *(right)* T$_2$-weighted images revealing the choroid plexus cysti (*arrow* in both images) obstructing the foramen of Monro on the right side. Dilation of the right lateral ventricle with bowing of the septum pellucidum can be noted.

TABLE 1
Reported cases of symptomatic choroid plexus cyst originating in the anterior and middle part of the lateral ventricle and obstructing the foramen of Monro

Authors & Year	Age, Sex	Surgery	Outcome
Andreussi, et al., 1979	3 yrs, M	total removal	good
Yoshida, et al., 1984	8 mos, M	partial removal	good
Goda, et al., 1990	30 yrs, M	partial removal	unknown
Nakase, et al., 1992	30 yrs, M	cyst opening	good
Parizek, et al., 1998	16 yrs, M	endoscopic	good
present case	53 yrs, F	total removal	good

ty (Table 1). All patients but one were males; in three children the cyst was located on the left side, and in the three adults it was on the right. As noted previously, the distribution of these cysts shows a preponderance for the male sex.[17,18]

Headache, especially episodic headache, is usually the most common symptom. Other symptoms associated with an increased intracranial pressure have also been reported, such as nausea, vomiting, gait disturbances, and head circumference enlargement in children.[8,14,17] Larger cysts may be associated with such symptoms and signs as confusion, convulsions, unilateral motor and/or sensory involvement, and coma.[14,17] These cysts need not reach a large size to cause symptoms. Because they are usually attached to the choroid plexus at one point, they may float freely within the ventricle and intermittently obstruct the circulation of CSF through the foramen of Monro, producing ipsilateral hydrocephalus.[8,15,17] This mass effect would explain the ipsilateral constant headache experienced by our patient, as well as the relief that ensued after resection of the cyst. This same phenomenon was described by Odake, et al.,[17] In our patient, the symptoms were triggered by a head trauma. Odake, et al.,[17] in a review of 30 patients with choroid plexus cysts, noted the association of head trauma in two of three patients with asymptomatic cysts who presented with headache.

Histologically, choroid plexus cysts consist of a fibrous outer membrane and an inner layer of cuboidal choroid plexus epithelium, often with ciliated cells.[1,13,17] These lesions have been related to the histogenesis of the choroid plexus. Most authors believe the origin of these lesions is the primitive neuroepithelium that lines the neural tube. The most unifying theory about their pathogenesis suggests that "a neuroepithelial tube or small cyst is formed by a folding of the neuroepithelium into the choroid's matrix and of stroma into the ventricle (evagination and invagination). It occurs as finger-like projections to create choroidal villi. The neck of the folded epithelial sacs occasionally may be pinched off and become separated from the ventricle. The accumulation of secretions from the secretory activity of these epithelial cells in the congenitally formed cyst and the fluid activity transported from the exterior will produce a clear CSF-like substance."[17]

Various methods have been used in the diagnosis of intraventricular cysts, including pneumoencephalography, ventriculography, ultrasonography for evaluating congenital abnormalities of the fetal brain, CT scanning, and MR imaging. Computerized tomography most often reveals a focal enlargement of the trigone with a well-defined low-density mass in the lateral ventricle of similar density to CSF. The cyst does not enhance after administration of contrast material, whereas the enhancing choroid plexus is usually displaced. Magnetic resonance imaging demonstrates the precise location of the cyst in the lateral ventricle. The cyst wall can be easily identified, even though it is very thin and closely applied to the ventricular lining. The content of the cyst has a signal on both T_1- and T_2-weighted MR images, corresponding to CSF.[6,14,17–19]

The differential diagnosis of choroid plexus cysts includes the following pathological processes: 1) parasitic cysts, as found in cysticercosis—intraventricular cysts occur in 11 to 17% of cases of central nervous system cysticercosis; they usually measure 1 to 2 cm in diameter, do not occur in children younger than 2 years of age, and may contain a mural nodule representing the scolex, which allows differentiation from a choroid cyst;[6] they are extremely rare in echinococcus;[2,6,16] 2) epidermoid cysts—the MR imaging appearance varies depending on the lipid and keratin content, and the cysts can potentially mimic a choroid plexus cyst;[2,13] 3) colloid cysts—the increased density observed on CT scans compared with the brain and the high signal intensity of the cholesterol-rich matrix of the colloid cyst demonstrated on MR images helps differentiate the colloid cyst from a choroid plexus cyst; (4) focal porencephaly—this may involve the lateral ventricle but does not produce mass effect or cause CSF blockage;[13] 5) arachnoid or ependymal cysts—diagnosis requires histological demonstration of arachnoid or ependymal cells in the cyst wall; ependymal cysts, in addition, tend to be intracerebral and to displace rather than expand the ventricle.[2,13]

Regarding treatment, it should be emphasized that the majority of these cysts are asymptomatic and only require periodic observation.[14] Spontaneous regression of intraventricular cysts has also been described.[6] There are several surgical options for treating symptomatic choroid plexus cysts: 1) creation of communication of the cyst cavity with the ventricle, either by open surgery or through ventriculoscopy; 2) placement of ventriculocystoperitoneal shunt; 3) stereotactic evacuation of the cyst content; and 4) direct surgical approach with total or partial resection of the lesion.

Simple fenestration of the outer membrane of the cyst when it arises in superficial locations seems to be the easiest and safest procedure, but there is a significant risk that the resected membrane will reform.[18] The placement of a ventriculocystoperitoneal shunt, in turn, is safer and should resolve the hydrocephalus;[13,14] however, this tends to be associated with a higher incidence of additional surgical procedures and the threat of life-long shunt dependency.[18] Pelletier, et al.,[19] performed a stereotactic puncture in which contents of the cyst were evacuated; the patient's preoperative headache rapidly improved and a follow-up CT scan revealed a decrease in the size of the cyst. Nevertheless, repeated punctures may be needed in such cases. The cysts have generally been surgically approached through the parietal or temporal cortex, or through a transcallosal route.[1,8,17,18] We prefer the transcallosal approach because it provides direct access to the ventricular system and causes the least morbidity to the cerebral cortex. In addition, the transcallosal route allows initial access to the more anterior portion of the cyst where

a vascular pedicle may be encountered. In a review of the literature encompassing 30 reported choroid plexus cysts,[17] partial resection and fenestration yielded inferior results compared with those achieved by total resection. There were no recurrences in cases of totally excised lesions. We recommend total resection of these lesions, especially when the cyst can be easily separated from the ependymal walls. In cases in which the lesion is large, drainage of its content may facilitate manipulation of the cyst. When the cyst is firmly adherent to surrounding brain close to the choroid plexus, it is better to leave a strip of the cyst wall undisturbed rather than risk injury to important fine vessels such as the anterior choroidal artery or the branches of the posterior cerebral artery.

Case 2: Chordoid Glioma

Presentation and Examination. This patient was a 57-year-old Caucasian, right-handed man whose history was significant for hypertension, diabetes mellitus, and an old myocardial infarct; he developed progressive episodes of worsening headache, generalized malaise, anorexia, and loss of olfactory sensation in April 1999. He underwent investigation including an MR imaging of the brain that revealed a 1.5-cm oval lesion centered in the region of the lamina terminalis, impinging on the superior part of the chiasm and compressing the anterior aspect of the third ventricle. The lesion was solid, isointense on T_1-weighted images, hyperintense on T_2-weighted images, and homogeneously enhancing following gadolinium administration. No evidence of hydrocephalus was noted.

First Operation and Histopathological Examination. Using a subfrontal approach, an open craniotomy and biopsy sampling (subtotal resection) of the tumor were performed at an outside institution in May 1999. The lesion was consistent with a chordoid glioma. The patient's hospital course was complicated by a left-sided parietal stroke and an anterior myocardial infarction on postoperative Days 1 and 2, respectively.
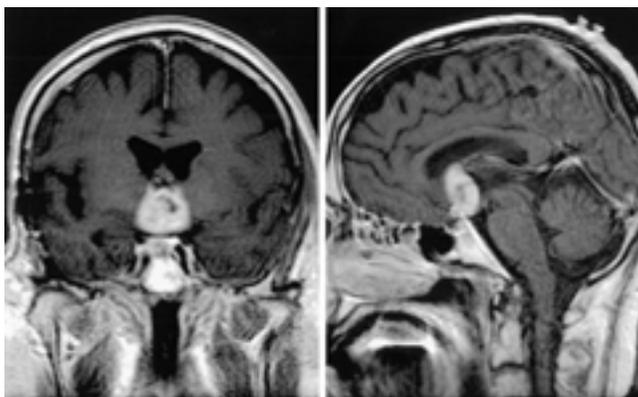
First Follow-Up Period. After a period of convales-

cence, the patient presented to M. D. Anderson for follow up. In August 1999, he finished a course of focal fractionated radiotherapy (54 Gy in 30 fractions). In March 2000, he was readmitted to our center with the complaint of headache, short-term memory loss, and worsening confusion and disorientation. A sodium level of 122 was identified, and the patient was diagnosed with the syndrome of inappropriate antidiuretic hormone secretion secondary to both the sensitive location of his brain tumor and to his congestive heart failure. This was successfully managed by fluid restriction. A follow-up MR image of the brain (Fig. 3) revealed progression of the third ventricle tumor, now 2 cm in diameter, with extension bilaterally into the foramina of Monro. A decision was made to resect this tumor. On neurological examination, the patient appeared somnolent, and symmetrical generalized whole-body weakness was noted.

Second Operation. In April 2000, a right frontal craniotomy was performed via a transcallosal approach. The floor of the right lateral ventricle anterior to the foramen of Monro was elevated. Dissection in this area revealed a soft, mildly vascular, light-grayish tumor arising from the suprachiasmatic cistern anterior to the third ventricle. The tumor, which appeared to be attached at the lamina terminalis, was well encapsulated and was completely resected. (Video Clip 2). Pathological examination confirmed the diagnosis of a chordoid glioma (Fig. 4).
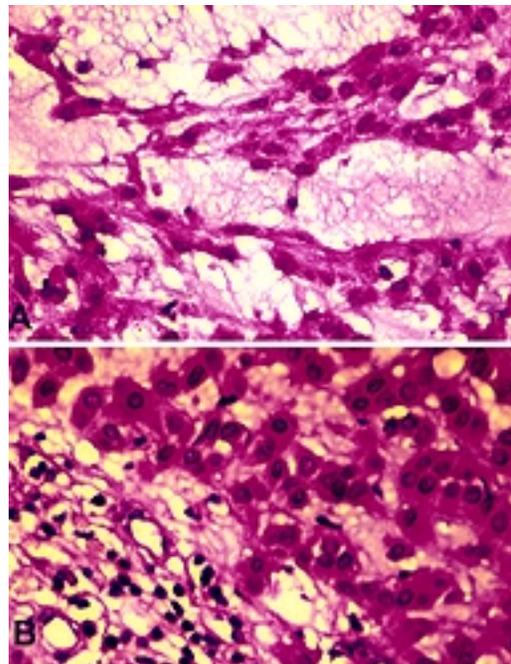
Click here to view Video Clip 2.

Fig. 4. Case 2. Photomicrographs. A: The tumor cells comprising chordoid glioma have benign-appearing round-to-oval nuclei and moderate amounts of eosinophilic cytoplasm. The mucinous background matrix is prominent in all cases. High-grade features are not seen. H & E, original magnification × 200. B: A characteristic feature of chordoid glioma is the presence of chronic inflammatory cell infiltrates, primarily lymphocytes, and plasma cells. H & E, original magnification × 200.

Fig. 3. Case 2. Coronal (left) and sagittal (right) T_1-weighted gadolinium-enhanced images demonstrating an oval lesion centered in the region of the lamina terminalis, impinging on the superior part of the chiasm and compressing the anterior aspect of the third ventricle. The lesion is homogeneously enhancing following gadolinium administration.
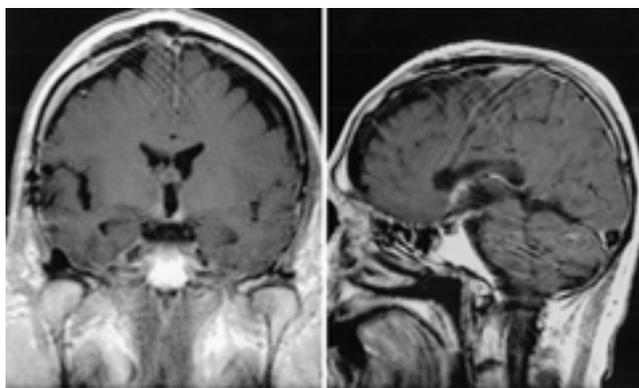
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Fig. 5. Case 2. Postoperative coronal *(left)* and sagittal *(right)* T$_1$-weighted gadolinium-enhanced MR images demonstrating gross-total excision of the tumor. (Note: radiation-induced enhancement seen on these images in the hypothalamic region should not be confused with tumor infiltration.)

Second Follow-Up Period. Postoperatively, the patient developed diabetes insipidus, which required the administration of desmopressin acetate for a period of 3 weeks, after which the patient was weaned from the medication. At last follow up on June 1, 2000, the patient denied experiencing headache since the surgery but complained of episodes of confusion. Magnetic resonance images revealed that gross-total resection the tumor had been achieved (Fig. 5). The patient died of a massive myocardial infarction on June 25, 2000.

Discussion

In 1998, Brat, et al.,[3] reported a series of eight patients harboring a peculiar new subtype of glioma called "chordoid glioma."[3] To date, 10 additional cases have been described, and the present study adds another (Table 2). The 18 previously reported cases included 13 women and five men.[3–5,20–23] The median age at diagnosis was 47 years and the age range was 31 to 70 years. The female/male ratio was 2:1. The tumor was located in the suprasellar region in all cases.

The clinical manifestations of this tumor are related to its proximity to several vital structures including the optic chiasm, the third ventricle, and the hypothalamus. Headache was the most common symptom reported by the patients.[3,20,23] Other clinical manifestations included obstructive hydrocephalus,[3,23] visual disturbances secondary to compression of the optic chiasm,[20,21] signs of increased intracranial pressure including somnolence, nausea, vomiting, memory deficits, and ataxia,[3,20,22,23] and endocrine disturbances such as amenorrhea, diabetes insipidus, syndrome of inappropriate antidiuretic hormone secretion, and hypothyroidism.[3,20,22]

Histological examination in the reported cases included findings of irregular cords of epithelioid cells with abundant eosinophilic background, without significant atypia or pleomorphism. Mitoses were exceedingly uncommon. Vascular proliferation and necrosis were absent. Mild to moderate lymphoplasmacytic infiltrates were present in all cases. No significant infiltration of the surrounding brain was noted. Cells were intensely and diffusely immunoreactive to glial fibrillary acidic protein in all cases, and slightly and focally reactive to epithelial membrane antigen in some cases. These cells lacked chromosomal and genetic alterations commonly found in other types of gliomas and meningiomas.[3–5,20,21,23]

In cases of tumors of the third ventricle valuable neurodiagnostic tools include CT and MR imaging. The CT scan typically reveals a well-circumscribed, hyperdense mass occupying the suprasellar/third ventricle area with homogeneous contrast enhancement. Magnetic resonance imaging reveals a solid, well-delineated mass, isointense on T$_1$- and T$_2$-weighted sequences, and enhancement following gadolinium administration. All lesions described to date were solid, except for one lesion that had a cystic component at the periphery of the mass.[22]

TABLE 2
Reported cases of chordoid glioma in the literature*

Authors & Year	Age (yrs), Sex	Resection	Radiotherapy	Outcome
Brat, et al., 1998	50, F	total	no	NS
	70, M	subtotal	no	stable at 1 yr
	59, F	subtotal	yes	died 3 yrs later of recurrence
	47, F	subtotal	no	died 8 mos later of medical complications
	31, F	total	no	disease free at 6 mos
	56, F	subtotal	no	stable at 1 yr
	31, F	subtotal	yes	mild increase in size of tumor after 4 yrs
	35, F	subtotal	no	died of pulmonary embolus postop
Reifenberger, et al., 1999	56, F	subtotal	yes	stable at 3.5 yrs
	53, F	NS	NS	NS
	65, M	total	no	died of pulmonary embolus postop
	35, M	total	no	died of pulmonary embolus postop
Vajtai, et al., 1999	60, F	subtotal	no	died of tracheobronchitis postop
Ricoy, et al., 2000	41, F	total	no	disease free at 13 mos
Tonami, et al., 2000	42, F	subtotal	yes	stable at 9 mos
Cenacchi, et al., 2001	34, M	total	no	disease free at 2 yrs
	40, M	total	no	disease free at 3 yrs
	43, F	total	no	died of pulmonary embolus postop
present case	57, M	subtotal	yes	died of myocardial infarction at 13 mos

* NS = not stated.

The differential diagnosis includes other solid tumors arising in the region of the third ventricle in adults. 1) Ependymoma and pilocytic astrocytoma are included in the differential diagnosis because of their low cytological malignancy and low infiltrative capacity. Unlike the former, chordoid glioma lacks the perivascular orientation of tumor cells, and unlike the latter, it lacks piloid cells, microcystic formation, and intratumoral Rosenthal fibers or granular bodies. 2) Chordoid meningioma and chordoma are considered because of the presence of epithelioid cells. Unlike meningioma, chordoid glioma lacks the cellular whorls, psammoma bodies, and nuclear pseudoinclusions. In addition, the immunophenotype of meningioma includes expression of epithelial membrane antigen but consistently lacks glial fibrillary acidic protein reactivity. Unlike chordoma, it lacks the physaliphorous cells. 3) Paraganglioma, central neurocytoma, craniopharyngioma, and ectopic pituitary adenoma are other entities in the differential diagnosis for tumors in this location.[3,22,23]

Despite their low-grade histological appearance, the location of the tumors in the third ventricle and their attachments to hypothalamic and suprasellar structures preclude complete resection, and this may result in recurrent tumor growth and less favorable prognosis. Of the 18 patients reported in the literature, a subtotal resection was performed in 10 patients, in two of whom the tumor recurred over a 3- to 4-year period; one patient died of tumor progression. The benefits of radiotherapy and/or chemotherapy after surgery for chordoid glioma are uncertain and may depend on the presence or absence of a residual tumor. Four of the reported patients underwent radiotherapy after subtotal resection. Tumor regrowth was noted in two cases during the years following radiotherapy.

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