EUROEPITHELIAL cysts are rare, benign cystic lesions that constitute fewer than 1% of intracranial tumors. Although the histogenesis of these lesions remains unclear, most authors agree on an embryogenetic origin. The majority of these lesions are asymptomatic and are diagnosed incidentally; however, lesions that become symptomatic frequently do so during adulthood. Although these cysts can be located anywhere within the neuraxis, they are frequently found adjacent to the supratentorial ventricular system or subarachnoid space. They are uncommonly located in the posterior fossa or brainstem, or adjacent to the fourth ventricle.

For asymptomatic, incidentally found lesions, it is generally agreed that conservative follow up should be recommended. Nevertheless, the treatment of symptomatic lesions has varied according to their locations and the surgical treatment available. Surgical management has yielded mixed results and has included stereotactic aspiration, internal drainage via placement of a cystosubarachnoid or cystoventricular shunt, external drainage via a reservoir system, craniotomy with cyst resection and/or fenestration, and endoscopic cyst fenestration into an adjacent subarachnoid or ventricular space.

In this paper we describe three cases of symptomatic thalamic neuroepithelial cysts associated with hydrocephalus. Each case was successfully treated between May 2002 and February 2004 by ETV and fenestration of the cyst into the third ventricle. The clinical presentation and findings in each case are summarized in Table 1.

Abbreviations used in this paper: CSF = cerebrospinal fluid; CT = computerized tomography; ETV = endoscopic third ventriculostomy; FLAIR = fluid-attenuated inversion recovery; ICU = intensive care unit; MR = magnetic resonance.

Case Reports

Case 1

Presentation and Examination. This 67-year-old right-handed man presented with a 6-month history of progressive balance difficulty, gait disturbance, short-term memory difficulty, and occasional urinary incontinence. During the physical examination he demonstrated recall of only one of three objects at 5 minutes; a broad-based, unsteady gait; and a slight upward gaze palsy. A review of MR images obtained in this patient revealed a multilobulated cystic mass that involved the right thalamus and extended into the right aspect of the brainstem. The lesion measured 2 cm at its greatest diameter and appeared isointense with CSF on all MR imaging sequences without any associated enhancement or FLAIR signal. A mass effect on the ventricular system caused the enlargement of the third and lateral ventricles that was consistent with obstructive hydrocephalus.

Operation and Postoperative Course. The patient underwent an uncomplicated ETV and fenestration of the cyst into the third ventricle. He was monitored for 1 night in the ICU and 1 night in the regular ward. He was discharged home on the 2nd postoperative day and has since participated in follow-up review for 24 months. Despite no obvious change in ventricle or cyst size on postoperative imaging, the patient described a significant improvement in symptoms, including resolution of urinary incontinence and improvement in balance, gait, and cognitive function.

Case 2

Presentation and Examination. This 42-year-old right-handed woman presented with an 8-month history of left hand tremor associated with difficulty performing fine
Endoscopic treatment of thalamic neuroepithelial cysts

TABLE 1
Clinical characteristics and outcome in three patients with symptomatic thalamic neuroepithelial cysts

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Duration (mos)</th>
<th>Symptoms</th>
<th>Findings of Physical Exam</th>
<th>Duration of Stay (days)</th>
<th>Follow Up (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67, M</td>
<td>6</td>
<td>gait &amp; balance disturbance, short-term memory difficulty, urinary incontinence</td>
<td>upward gaze palsy, poor remote recall, broad-based &amp; unsteady gait</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>42, F</td>
<td>8</td>
<td>lt hand tremor, headache, nausea, blurry vision</td>
<td>fine lt hand tremor when in outstretched prone position</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>72, F</td>
<td>3</td>
<td>gait &amp; balance disturbance, memory difficulty, slowed cognition</td>
<td>flat affect, slow speech, shuffling &amp; slow gait</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Operation and Postoperative Course. The patient underwent an uncomplicated ETV and fenestration of the cyst into the third ventricle. She was monitored overnight in the ICU and discharged home on the 1st postoperative day. She has participated in follow-up review for 6 months. Postoperative MR imaging at 3 months demonstrated significantly decreased cyst and ventricle size (Fig. 1B). The patient reported resolution of her severe headaches as well as complete resolution of the left hand tremor, with improvement in her ability to perform fine motor tasks.

Case 3

Presentation and Examination. This 72-year-old, right-handed woman presented with a 3-month history of progressive headaches, which were most severe when she was lying flat and were occasionally accompanied by nausea and blurry vision. The neurological examination yielded normal findings, except for a fine tremor of her left hand when held in an outstretched prone position. A review of MR imaging studies revealed a multilobulated cystic mass, measuring approximately 2 × 3 cm, involving the posterior aspect of the right thalamus with extension into the right midbrain (Fig. 1A). The mass appeared isointense with CSF on all MR imaging sequences without any associated enhancement or FLAIR signal. A mass effect on the third ventricle caused the enlargement of the lateral ventricle with some evidence of transependymal flow, which was consistent with obstructive hydrocephalus.
gressive gait disturbance, memory difficulties, and slowing of her thought processes. During the neurological examination she was noted to have a flat affect; slow speech; and a slow, shuffling gait. A review of her MR imaging studies revealed a cystic mass, approximately 2 cm in its greatest diameter, involving the medial aspect of the right thalamus (Fig. 2A). Similar to the previous cases, the mass appeared isointense with CSF on all MR imaging sequences without any associated enhancement or FLAIR signal. A mass effect on the third ventricle caused enlargement of the lateral ventricle with evidence of transependymal flow, which was consistent with obstructive hydrocephalus.

**Operation and Postoperative Course.** The patient underwent an uncomplicated ETV and fenestration of the cyst into the third ventricle. She was monitored overnight in the ICU before being transferred to the regular ward. She was discharged home on the 3rd postoperative day and has since been evaluated in follow-up review for 3 months. The patient has described significant improvements in gait stability, cognitive functioning, and speech clarity. Postoperative MR images have demonstrated decreased cyst and ventricle size with less periventricular signal and a clearly patent communication between the third ventricle and the prepontine cistern (Fig. 2B).

**Endoscopic Procedure**

A 0°, 6-mm, rigid-rod lens neuroendoscope with a working channel (Minop; Aesculap, Tuttlingen, Germany) was used for each procedure. A standard ETV was created through a coronal burr hole centered 3 cm from the midline. A second, more anterior frontal burr hole, also located 3 cm from the midline at the level of the hairline, was used for access to the cyst. The neuroendoscope was passed into the frontal horn of the lateral ventricle through this anterior burr hole. This approach to the ipsilateral foramen of Monro allowed unobstructed visualization of the posten-
Endoscopic treatment of thalamic neuroepithelial cysts

### Discussion

Intracerebral cysts can be broadly categorized into neoplastic and nonneoplastic lesions. In benign nonneoplastic lesions, classification is often based on the anatomical location of the mass or the nature of the lining membrane. The term “neuroepithelial cyst” refers to an ependymal or ependymal-lined lesion that can be located anywhere within the neuraxis. Most frequently, however, these cysts are found adjacent to the ventricular system or the subarachnoid space.1

Although the exact causes of neuroepithelial cysts remain uncertain, most authors agree on the cysts’ histological features, which are reminiscent of the choroid plexus or ependymal epithelium; a developmental error occurring during an early stage of neuroectodermal differentiation is the most likely explanation.1,6,10 Despite the embryogenic origin of these cysts, if they become symptomatic, they frequently do so during adulthood. The most common presenting symptoms include headache and other symptoms of elevated intracranial pressure, seizures, and progressive focal neurological deficits.10

The CT and MR imaging characteristics of these lesions have been well described.7,15,18 Characteristics suggestive of a benign cyst include the lack of an obvious cyst wall or associated soft-tissue mass, homogeneous consistency, signal intensity identical to that of CSF, lack of surrounding edema or gliosis, and lack of contrast enhancement.14 Based on these criteria, each case presented here demonstrated the MR imaging characteristics suggestive of a benign cyst. The mass effect associated with each cyst in our series caused compression of the third ventricle and obstructive hydrocephalus with varying amounts of abnormal periventricular signal.

Table 2 outlines reports we identified in the literature of thalamic neuroepithelial cysts. In five of the 10 reported cases the cysts were incidental findings during a neuroimaging workup of symptoms most likely unrelated to the lesion.3,8,15,16 Four of these five cysts were conservatively managed with observation, whereas the fifth was surgically aspirated. In the latter case, this procedure resulted in a minimal postoperative change in the size and appearance of the lesion on neuroimages. Of the five cases in which patients presented with symptoms referable to the identified thalamic cyst, in four the primary complaint was a movement disorder—most commonly a contralateral upper-extremity tremor.4,8,15,16 In contrast to our series, hydrocephalus was present in only one of the five cases.9

On the whole, the surgical management of symptomatic intracranial cysts (including neuroepithelial, colloid, and arachnoid cysts among others) has varied widely. Some of the earliest reports offer descriptions of accessing the cyst via a craniotomy with either cyst resection or fenestration to the subarachnoid space or ventricular system.1,4,12,14,15,19 Although this frequently proved to be effective, a desire for a less invasive method of treating these lesions led to later

### Table 2

Reported cases of thalamic neuroepithelial cysts

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Patient Age (Yrs), Sex</th>
<th>Symptoms Promoting Imaging Studies</th>
<th>Lesion Location</th>
<th>Management</th>
<th>Outcome</th>
<th>Follow Up (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numaguchi, et al., 1987</td>
<td>37, M</td>
<td>depression, mood swings, rt hand resting tremor</td>
<td>lt thalamus</td>
<td>posterior fossa craniotomy cyst aspiration</td>
<td>slight resolution of hand tremor</td>
<td>1</td>
</tr>
<tr>
<td>Sherman, et al., 1990</td>
<td>34, F</td>
<td>rt facial pain</td>
<td>lt thalamus</td>
<td>carbamazepine therapy</td>
<td>decreased cyst &amp; ventricle size on CT scan</td>
<td>—</td>
</tr>
<tr>
<td>Bejar, et al., 1992</td>
<td>66, F</td>
<td>migraines headaches</td>
<td>lt midline paraventricular</td>
<td>craniotomy, cyst drainage</td>
<td>no change in CT appearance</td>
<td>36</td>
</tr>
<tr>
<td>Rajshekar, 1995</td>
<td>21, F</td>
<td>rt hemiballism &amp; tremor, upward gaze paralysis</td>
<td>rt thalamus</td>
<td>CT-guided stereotactic cyst aspiration</td>
<td>resolved hemiballism, improved tremor, residual cyst on CT scan</td>
<td>11</td>
</tr>
<tr>
<td>Guermazi, et al., 1998</td>
<td>11, F</td>
<td>lt postural tremor</td>
<td>rt thalamus &amp; basal ganglia</td>
<td>salicylate therapy, biopsy &amp; aspiration</td>
<td>resolved headache, slight decrease in cyst size on CT scan</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Herrera, et al., 1999</td>
<td>28, F</td>
<td>postpartum migraine headache</td>
<td>lt thalamus</td>
<td>observation</td>
<td>no change in MRI appearance</td>
<td>44</td>
</tr>
<tr>
<td>49, F</td>
<td>migraines headaches</td>
<td>lt thalamus/ midbrain</td>
<td>salicylate therapy, biopsy &amp; aspiration</td>
<td>observation</td>
<td>no change in MRI appearance</td>
<td>44</td>
</tr>
<tr>
<td>48, F</td>
<td>lt hearing loss</td>
<td>lt thalamus</td>
<td>stereotactic placement of Rickham catheter cyst fenestration</td>
<td>observation</td>
<td>decreased cyst size &amp; resolved hydrocephalus on immediate postop CT scan</td>
<td>12</td>
</tr>
<tr>
<td>Heran, et al., 2003</td>
<td>6, M</td>
<td>rt hemiplegia, aphasia, intracranial hypertension</td>
<td>lt thalamus</td>
<td>stereotactic cyst aspiration</td>
<td>initial symptom resolution w/ recurrence at 6 yrs &amp; increased cyst size, recurrence of symptoms 1 yr after 2nd drainage procedure</td>
<td>&gt;84</td>
</tr>
</tbody>
</table>

* — = Data not given.
reports of stereotactic aspiration and internal or external drainage via a shunt or reservoir system.2,7–9 In the cases treated by Heran, et al.,3 stereotactic aspiration proved to be less effective with both patients experiencing symptomatic worsening reflective of cyst enlargement. One patient declined additional surgical management, whereas the other underwent a second attempt at stereotactic aspiration and ultimately placement of an intracystic Ommaya reservoir when her symptoms returned a second time.3 Most recently, endoscopic procedures have provided a minimally invasive way to treat many different neurosurgical lesions under direct visualization. In an early review of endoscopic techniques, Auer and colleagues2 described the use of an endoscope to perform diagnostic biopsies; drainage procedures; and removal of cystic brain tumors, ventricular tumors, and intracranial hematomas with a very low complication rate. Other authors have followed with reports of endoscopic treatment of other intracranial cystic lesions, primarily arachnoid cysts, via fenestration to adjacent subarachnoid spaces or the ventricular system.3,17 Nevertheless, prior to publication of our series, there have been no other reports in the literature of endoscopic treatment of symptomatic neuroepithelial cysts by ETV and fenestration of the cyst into the third ventricle.

In this article, we present three unique cases of thalamic cysts with associated hydrocephalus. Each patient was symptomatic, either from local compression (Case 2, tremor) or hydrocephalus (Cases 1 and 3, gait and cognitive changes; Case 2, headache). All three cases were effectively and safely treated by ETV and fenestration of the cyst into the third ventricle. We did not believe that the additional risk of intracystic or intraventricular hemorrhage incurred by sampling of the cyst walls for definitive histological analysis would provide any added benefit to the patient or change our treatment strategy in any way. The lesions were presumed to be benign neuroepithelial cysts based on their clinical presentations and neuroimaging characteristics. Each patient experienced remarkable improvements in symptoms, although only a minimal change in ventricle size was observed in Cases 2 and 3; no change was observed in Case 1. Despite the lack of a marked neuroimaging change in ventricle size in all cases and a relatively short follow-up period for Cases 2 and 3, the patients’ improvements in symptoms indicate successful treatment. Although by itself, endoscopic fenestration into the ventricular system may serve to be an adequate treatment for a thalamic cyst, the addition of ETV to the procedure allows treatment of associated hydrocephalus while providing an additional outlet for cyst fluid to the subarachnoid space. The endoscopic technique allowed direct decompression of the cyst and physiological treatment of the hydrocephalus, and avoided placement of ventriculoperitoneal or cystoperitoneal shunts or reservoir systems with their inherent possible complications.

We believe that the method of ETV described in this paper combined with endoscopic cyst fenestration is an effective, minimally invasive way of treating selected patients with symptomatic thalamic neuroepithelial cysts.

References

Manuscript received July 21, 2004. Accepted in final form April 12, 2005.
Address reprint requests to: Kelly Schmidt, M.D., Department of Neurosurgery, University of Texas at Southwestern Medical Center, 5323 Harry Hines Boulevard, Dallas, Texas 75235. email: kellyschmidt@sbcglobal.net.