Endoscopic treatment of colloid cysts of the third ventricle

Technical note and review of the literature

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The surgical technique for the endoscopic evacuation of colloid cysts of the third ventricle in 13 patients is described. The authors conclude that endoscopic resection of these lesions is a useful addition to the current surgical repertoire and a viable alternative to stereotactic aspiration or open craniotomy.

KEY WORDS • colloid cyst • brain neoplasm • third ventricle • endoscopy • aspiration

Colloid cysts of the third ventricle are benign lesions comprising between 0.5% and 1% of all brain tumors. They are thin-walled, spherical cysts composed of a collagenous capsule, an underlying epithelium, and a gelatinous center of variable viscosity. The cysts are usually attached to the anterior aspect of the velum interpositum or to the choroid plexus of the third ventricle near the foramina of Monro.

Colloid cysts may be found incidentally at autopsy in patients who expressed no neurological complaints or, in other patients, these cysts may obstruct the foramina of Monro, producing hydrocephalus, intracranial hypertension, and subsequent neurological dysfunction. The treatment objective is to decompress the foramina of Monro by resecting the obstructing lesion or evacuating its contents. Traditional surgical options include microsurgical resection or stereotactic aspiration. Cerebrospinal fluid shunt placement alone is usually reserved for those patients who are considered medically too unstable to undergo a more definitive procedure. Because of the limitations of each of these approaches, endoscopic evacuation of colloid cysts has been explored.

In this report we describe a technique for endoscopic management of colloid cysts. When applicable, it permits removal of the cyst contents and much of the cyst wall with minimal manipulation of normal brain structures.

Clinical Material and Methods

Patient Population

Between January 1991 and April 1997, 13 consecutive patients underwent endoscopic surgery to remove a colloid cyst of the third ventricle. Six patients were men and seven were women. The age at presentation ranged from 26 to 65 years with a mean age of 39 years. Headache was the most frequent complaint and was present in 12 of 13 patients. Deterioration of memory function, ataxia, dizziness, blurred vision, and nausea and vomiting were seen in individual patients. One patient presented with obtundation and incipient herniation, but awakened after emergency ventriculostomy placement. Eight of the 13 patients presented with papilledema. Impaired short-term memory was present in six patients. Two patients had truncal ataxia, and one had urinary incontinence. No patient presented with weakness or seizures (Table 1).

All patients were evaluated radiographically using magnetic resonance (MR) imaging of the brain. Some patients
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underwent computerized tomography (CT) scanning of the head, which was performed by the referring physician. The lesions were greater than 5 mm in diameter in all patients and produced hydrocephalus with variable degrees of ventricle enlargement. Magnetic resonance imaging was especially useful in determining the location of the colloid cyst in the midsagittal section beneath the roof of the third ventricle. Three of the 13 patients had relatively posterior lesions that were “tucked up” under the roof of the third ventricle. This information was used in planning the trajectory of the endoscope and the location of the burr hole.

Twelve patients underwent endoscopic evacuation of the colloid cyst as the initial mode of therapy. One patient had undergone right ventriculoperitoneal shunt placement by the referring neurosurgeon before transfer to our institution. He subsequently underwent endoscopic evacuation of his colloid cyst under our care.

Operative Technique

Antibiotic medications are administered preoperatively and continued for 24 hours postoperatively, but anticonvulsant medications are not used.

General endotracheal anesthesia is administered in almost all patients, except rare individuals who have significant medical problems and risk factors that prohibit use of a general anesthetic. The patient is positioned supine on doughnut-shaped foam with the brow facing upward and with the head of the bed elevated to 30°. Although we usually use a Phalen instrument table, an alternative side instrument table could be used. Despite earlier experience with flexible endoscopes, we currently prefer to use a rigid endoscope because of its greater light intensity and superior optics. A single scrub nurse and two circulating nurses are present. One circulating nurse is dedicated to operating the endoscopic and video equipment as well as the laser.

A small portion of the anterior scalp on the appropriate side is shaved, prepared, and draped. Endoscopic ventricular access is preferentially performed on the right side, except when asymmetric ventricular enlargement has caused the left lateral ventricle to be significantly larger than the right. After skin incision, a single precoronal burr hole is made. The burr hole is usually placed anterior to the coronal suture and lateral to the midpupillary line. The lateral placement of the burr hole permits better visualization of midline structures, especially the septum pellucidum, which will be fenestrated at the end of the procedure. A burr hole is placed more anteriorly in those patients in whom the lesion is located more posteriorly. The lateral ventricle is entered. A rigid 4-mm-diameter 0° (straight forward) solid rod lens is inserted into the introducer and the image is projected on a video monitor via a microchip camera. The video monitor is positioned so that it can easily be viewed without the operating surgeon having to turn.

The lateral ventricle is inspected. The regional anatomy is defined, including the relationships among the foramen of Monro, the fornix, the septal and thalamostriate veins, the choroid plexus, and the colloid cyst. The cyst wall can usually be seen lying beneath the dilated foramen and partially covered by the choroid plexus. In a minority of patients, however, the colloid cyst is situated more posteriorly, tucked up underneath the roof of the third ventricle. These posteriorly placed lesions may deform the ventricular floor superiorly and produce a slitlike foramen of Monro, making endoscopic evacuation more difficult (Fig. 1).

The viewing lens is withdrawn and replaced by a smaller 2.2-mm-diameter rigid lens with a central working channel. An endoscopic bipolar cautery device is introduced through the working channel to coagulate any portion of the choroid plexus that partially covers the foramen of Monro and to shrink vessels on the surface of the cyst. The cyst wall is opened using an 800-μm-diameter fiberoptic neodymium–yttrium aluminum garnet (Nd-YAG) laser set at 10 to 20 W. Care is taken to avoid injuring the fornix. Opening the tough cyst wall by using bipolar cautery is usually unsuccessful. The area is continuously irrigated using warm lactated Ringer’s solution. The cyst contents, which are often quite viscous, are removed piecemeal by using a suction catheter with syringe aspiration or grasping forceps (Fig. 2). In this way, the procedure is continued until all reachable contents are removed. Because this step forms the heart of the decompression, it is important that it be continued until as much of the cyst contents as possible have been removed.

Total resection of the cyst wall is usually not possible. All accessible fragments of the cyst capsule are removed using microscissors or shrunken with bipolar cautery. Removal of the capsule using grasping forceps and traction should be performed with caution because bleeding

<table>
<thead>
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<th>Findings</th>
<th>No. of Patients (%)</th>
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<tbody>
<tr>
<td>symptoms &amp; signs</td>
<td>12 (92)</td>
</tr>
<tr>
<td>headache</td>
<td>1 (8)</td>
</tr>
<tr>
<td>nausea/vomiting</td>
<td>6 (46)</td>
</tr>
<tr>
<td>memory deterioration</td>
<td>2 (15)</td>
</tr>
<tr>
<td>blurred vision</td>
<td>2 (15)</td>
</tr>
<tr>
<td>dizziness</td>
<td>2 (15)</td>
</tr>
<tr>
<td>drop attacks</td>
<td>2 (15)</td>
</tr>
<tr>
<td>urinary incontinence</td>
<td>1 (8)</td>
</tr>
<tr>
<td>ataxia</td>
<td>2 (15)</td>
</tr>
<tr>
<td>papilledema</td>
<td>8 (62)</td>
</tr>
<tr>
<td>radiographic findings</td>
<td></td>
</tr>
<tr>
<td>hydrocephalus</td>
<td>13 (100)</td>
</tr>
<tr>
<td>lesion tucked up beneath</td>
<td></td>
</tr>
<tr>
<td>roof of third ventricle</td>
<td>3 (23)</td>
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from partially avulsed vessels along the roof of the third ventricle can be difficult to control. Hemostasis must be continuously maintained throughout the procedure because a small amount of bleeding will quickly color the cerebrospinal fluid and obscure the operative site.

After the cyst contents are evacuated and the capsule is shrunk by cautery, the ventricle is thoroughly irrigated and the foramen of Monro is inspected to ensure its patency. The endoscope and introducer are withdrawn slightly and the septum pellucidum is visualized and fenestrated using bipolar cautery or the Nd-YAG laser. The hole is enlarged with microscissors and/or a Fogarty balloon catheter. The contralateral ventricle is entered through the fenestration and the contralateral foramen of Monro is inspected, when possible, to ensure its patency. The endoscope and introducer are returned to the ipsilateral ventricle and the endoscope is withdrawn. The ventricle is gently irrigated through the introducer and the introducer is withdrawn.

The bone defect is covered with a single piece of Gelfoam and the galea and skin are closed in layers. A titanium burr hole cover may be used in selected patients to optimize the cosmetic result. Early in our series, a temporary external ventricular drain was placed in patients at the end of the procedure to safeguard against early postoperative hydrocephalus. With evolving experience, however, this precaution has proven to be unnecessary.

Results

Ten of the 13 patients who underwent the endoscopic procedure required no other operations. In the patient who had previously undergone ventriculoperitoneal shunt placement by the referring physician, the device was turned off at the time of the endoscopic procedure. In one patient a large cyst was incompletely resected and a sec-
endoscopic procedure to evacuate the cyst completely was required. A ventriculoperitoneal shunt was placed at the time of the second procedure to ensure resolution of the patient’s hydrocephalus. Three patients had posteriorly placed lesions that were tucked up underneath the roof of the third ventricle; these cysts proved to be more difficult to evacuate endoscopically. In one of these patients complete cyst removal was achieved during the first endoscopic procedure and the patient required no other operations. The second patient required shunt placement after initial subtotal endoscopic evacuation and the third underwent open microsurgical resection after an attempt at endoscopic evacuation produced only modest volume reduction. The last patient required ventriculoperitoneal shunt placement despite complete resection of the cyst, as documented by imaging after the second procedure. In total, our 13 patients underwent 16 procedures; near-complete cyst resection was achieved in 10, whereas three received incomplete resection. Three of the 13 patients required long-term shunt placement.

Headache and nausea and vomiting were significantly improved or resolved in all patients who presented with these complaints. Of the six patients with preoperative short-term memory impairment, two had transient postoperative deterioration with subsequent return to preoperative baseline and two were improved postoperatively when compared with their preoperative condition. One of seven patients with normal memory function experienced transient postoperative deterioration with subsequent return to baseline. The individual patients with truncal ataxia and urinary incontinence had no notable change in these symptoms after surgery. The preoperative diagnosis of colloid cyst was confirmed in all seven patients for whom tissue was submitted for histological examination.

All patients who were employed preoperatively were able to return to work. One patient underwent surgery with only a local anesthetic because of significant medical problems; this patient died 4 years later from complications of long-standing heart and renal disease. None of the other patients has experienced clinical or radiographic recurrence after a follow-up period of 6 months to 7 years (mean 4 years).

Illustrative Case

This 41-year-old man with no significant medical history collapsed while arguing with his friend. He awakened minutes later complaining of a severe headache.

Examination. The patient was transported to the hospital where he was found to be neurologically intact. A noncontrast-enhanced CT scan demonstrated a third ventricular cyst with moderate hydrocephalus. Magnetic resonance images of the brain revealed a cystic lesion within the anterior aspect of the third ventricle (Fig. 3A–C).

Endoscopic Treatment. The patient underwent endoscopic evacuation of the colloid cyst through a left frontal burr hole. Although the cyst contents were quite viscous and tenacious, they were successfully removed using catheter suction and grasping forceps.

Postoperative Course. The patient had no postoperative neurological deficits and was discharged on postoperative Day 2. At the time of his routine 6-week postoperative visit, the patient had returned to his full-time occupation and complained only of mild, intermittent headaches. A follow-up MR image obtained 1 year after surgery demonstrated near-complete cyst removal and resolution of the hydrocephalus (Fig. 3D).

Discussion

Colloid cysts are benign, well-circumscribed lesions that rarely recur after radical excision. It is their location within the anterior aspect of the third ventricle and proximity to the foramina of Monro and important neural and vascular structures that account for the clinical symptoms they produce and the risks they pose for perioperative morbidity.

Craniotomy with microsurgical resection of the cyst is presently the favored form of treatment. The lesion may be approached through the foramen of Monro after transcortical access to the lateral ventricle or more directly through the corpus callosum. Although craniotomy permits radical removal of the cyst wall and minimizes the likelihood of recurrence, it is not without risk. In a retro-
spective review of 84 patients with colloid cysts treated at the Mayo Clinic, Camacho, et al.\textsuperscript{6} noted that 10 of 36 patients who underwent transcortical–transventricular resection had a postoperative complication. Antunes and colleagues\textsuperscript{5} reported six deaths and four complications in 23 patients who had undergone colloid cyst resection via the transcortical–transventricular route. Although Fritsch\textsuperscript{12} reported no postoperative neurological deficits in 18 patients treated with this approach, six required shunt placement. Morita and Kelly\textsuperscript{27} reported 10 complications in 30 patients including postoperative hydrocephalus, subdural hygroma, syndrome of inappropriate antiidiuretic hormone, and short-term memory dysfunction.

The more direct transcallosal approach to the third ventricle, which has recently gained popularity, avoids cortical disruption. Nevertheless, it carries the risks of sagittal sinus thrombosis, venous infarction from division of bridging veins, inadvertent damage to the pericallosal arteries, injury to the fornix, and development of a disconnection syndrome. In patients who underwent a transcallosal approach to the third ventricle, Shucart and Stein\textsuperscript{31} noted that one of six patients with a colloid cyst had postoperative hemiparesis from venous infarction and one of two patients with a craniopharyngioma had postoperative mutism. Of three patients who underwent a transcortical approach to the third ventricle, Jeeves, et al.,\textsuperscript{17} noted that two patients suffered postoperative short-term memory deficits as a result of injury to the fornix and one required ventricular shunting. Of the 17 patients with a colloid cyst treated by Hall and Lunsford,\textsuperscript{15} the transcallosal approach was used in eight patients, two of whom experienced postoperative hemiparesis from venous infarction. Authors of more recent series have reported better results. In 1996, Hernesniemi and Leivo\textsuperscript{16} noted good functional outcomes in 31 patients who underwent transcallosal resection of a colloid cyst. Of these patients, one had postoperative memory deficit, another had a venous infarction with hemorrhage, and a third had a chronic subdural hematoma. Postoperative infection was noted in two additional patients; one had a brain abscess and hemiparesis and the other had a superficial wound infection. Only one patient required ventricular shunt placement.

The search for a less invasive way to treat these patients prompted Gutierrez-Lara, et al.,\textsuperscript{24} to introduce freehand aspiration of colloid cysts in 1975. Using this approach, the authors successfully treated five patients with no significant perioperative complications. The technique was refined by Bosch and coworkers,\textsuperscript{4} who performed cyst aspiration by using stereotactic guidance in four patients. This group reported a good outcome in all four patients; however, one of them required a second stereotactic aspiration and another required ventriculovenous shunt placement.

No neurological deficit as a result of surgery was noted in either study. Subsequently, Rivas and Lobato\textsuperscript{30} reported the successful use of stereotactic aspiration in three patients and Donauer, et al.,\textsuperscript{25} and Mohadjer, et al.,\textsuperscript{26} noted good operative results in 10 and 12 patients, respectively. These reports stress the operative simplicity and low complication rate of this approach.

The initial enthusiasm for stereotactic aspiration has been tempered by its lack of success in treating some patients. In those patients, a mobile cyst with a tough outer capsule may be pushed away by the needle or, alternatively, the cyst contents may be too viscous to aspirate despite successful puncture of the capsule. The latter point was supported by Kondziolka and Lunsford,\textsuperscript{19} who noted that cysts in which the contents appear hypodense on CT scanning were more likely to be successfully aspirated than those with a hyperdense center. Moreover, simple aspiration may lead to a high recurrence rate because the cyst wall has not been resected or even widely fenestrated. Mathiesen and associates\textsuperscript{\textendash}3 assessed the long-term outcome of stereotactic colloid cyst aspiration in 16 patients. Thirteen patients required subsequent procedures, which included a second aspiration in six, two additional aspirations in two, and microsurgical resection in five patients. In all, a total of 26 stereotactic aspirations were performed. Three patients had transient postoperative memory deficit and one patient experienced a central pain syndrome. In addition, 11 aspirated cysts recurred and seven of these did not become evident until 8 or more years after the initial procedure. Four of the 16 patients in this series suffered transtentorial herniation from untreated hydrocephalus at some point after surgery. The authors concluded that all patients undergoing stereotactic colloid cyst aspiration should undergo indefinite follow-up CT scanning.

Endoscopic surgery provides a balanced middle ground between craniotomy and stereotactic aspiration. It permits wide fenestration of the capsule and aspiration of the cyst contents under direct vision with minimal disruption of the cortex and other normal brain structures. The endoscope is an ideal instrument for exploration of fluid-filled cavities, and the intraventricular location of colloid cysts makes these lesions particularly accessible to the endoscopist.

Endoscopic aspiration of colloid cysts was reported in 1983 by Powell, et al.\textsuperscript{29} In 1988, Auer, et al.,\textsuperscript{2} aspirated a colloid cyst and coagulated the wall by using a Nd-YAG laser. Subsequently, Cohen and Shucart\textsuperscript{1} removed two colloid cysts and partially removed a third cyst by using a flexible endoscope. In 1994, Lewis and coworkers\textsuperscript{21} reported their experience with colloid cysts and compared the results of endoscopic and microsurgical resection. In that series, eight patients underwent microsurgery and seven underwent endoscopic resection. Patients in the endoscopy group had a shorter operative time and overall hospital stay and a lower perioperative complication rate; they also returned to work earlier than the microsurgery group. None of the patients who underwent endoscopy required conversion of the operation into an open craniotomy. More recently, Caemaert and Abdullah\textsuperscript{3} reported on a series of patients with colloid cysts who underwent endoscopic treatment. In their six endoscopic procedures, there were three subtotal and three total resections. Hydrocephalus was successfully treated in all patients and none required shunt placement.

In 1991, Eiras and Alberdi\textsuperscript{11} reported the successful endoscopic management of eight patients with various intracranial lesions including one colloid cyst. Merienne, et al.,\textsuperscript{25} treated four patients endoscopically, two of whom had colloid cysts. In 1994, Grunert and colleagues\textsuperscript{13} reported their endoscopic experience with 18 patients, three of whom had colloid cysts. Dembnerger and associates\textsuperscript{3} reported on four patients who underwent endoscopic evacuation of colloid cysts of the third ventricle. A good
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clinical outcome with minimal neurological morbidity was noted by all authors.

Our operative technique is similar to that of other authors with several exceptions. We believe that most patients with colloid cysts of the third ventricle are candidates for endoscopic evacuation. Patients with posteriorly placed lesions that appear to be tucked up underneath the roof of the third ventricle on midsagittal MR images are the only relative exception because these lesions have proven to be more difficult to evacuate using the rigid endoscope. Unlike Kondziolka and Lunsford,20 we do not pursue initial stereotactic aspiration and reserve endoscopy for those patients in whom aspiration fails. That approach dictates that only those patients with less favorable cysts (thicker capsule or more tenacious contents) undergo endoscopic evacuation and this may explain the unexpectedly large failure rate reported for the endoscopy group by those authors.

The endoscopic evacuation of colloid cysts is usually performed after general endotracheal anesthesia has been administered. Although some authors choose to cannulate the ventricle freehand insertion is easily accomplished in these hydrocephalic patients. The cyst wall is widely fenestrated, the contents are evacuated, the accessible capsule fragments are removed, and the remainder of the capsule is excised using grasping forceps and gentle traction. This maneuver may be unnecessary and potentially dangerous because bleeding from partially avulsed vessels along the roof of the third ventricle may be quite difficult to control.

The endoscopic evacuation of colloid cysts is a useful addition to the surgical armamentarium and is presented here as an option in the surgical management of these lesions. As with any endoscopic procedure, physicians face a learning curve for the use of this technique. The growing clinical experience with neuroendoscopy and continuing technical developments in the field will most likely lead to better clinical outcomes in patients in the future. Although the rate of colloid cyst recurrence after endoscopic evacuation appears to be low, we are cautioned by the findings of Mathiesen, et al.,23 who demonstrated that some cysts may recur many years after stereotactic aspiration. We agree with Caemaert and Abdullah,24 however, that the recurrence rate of endoscopic evacuation of a colloid cyst should be comparable to that of microsurgical resection.

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References


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