Combined endoscopic transforaminal-transchoroidal approach for the treatment of third ventricle colloid cysts

Technical note

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Colloid cysts are histologically benign lesions whose primary goal of treatment should be complete resection to avoid recurrence and sudden death. Open surgery is traditionally considered the standard approach, but, recently, the endoscopic technique has been recognized as a viable and safe alternative to microsurgery. The endoscopic approach to colloid cysts of the third ventricle is usually performed through the foramen of Monro. However, this route does not provide adequate visualization of the cyst attachment on the tela choroidea. The combined endoscopic transforaminal-transchoroidal approach (ETTA), providing exposure of the entire cyst and a better visualization of the tela choroidea, could increase the chances of achieving a complete cyst resection. Between April 2005 and February 2011, 19 patients with symptomatic colloid cyst of the third ventricle underwent an endoscopic transfrontal-transforaminal approach. Five of these patients, harboring a cyst firmly adherent to the tela choroidea or attached to the middle/posterior roof of the third ventricle, required a combined ETTA. Postoperative MRI documented a gross-total resection in all 5 cases. There were no major complications and only 1 patient experienced a transient worsening of the memory deficit. To date, no cyst recurrence has been observed. An ETTA is a minimally invasive procedure that can allow for a safe and complete resection of third ventricle colloid cysts, even in cases in which the lesions are firmly attached to the tela choroidea or located in the middle/posterior roof of the third ventricle.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.

Abbreviation used in this paper: ETTA = endoscopic transforaminal-transchoroidal approach.
the combined endoscopic transforaminal-transchoroidal approach (ETTA) to colloid cysts of the third ventricle and report our experience with this procedure.

**Methods**

Between April 2005 and February 2011, 19 patients with symptomatic colloid cyst of the third ventricle were treated endoscopically in a surgery performed via a monoportal transfrontal-transventricular approach. The usual transforaminal route was used in 13 patients harboring a colloid cyst located in the anterior part of the third ventricle, and a combined ETTA was used in the remaining 5 patients who harbored a lesion firmly adherent to the tela choroidea or attached to the middle/posterior roof of the third ventricle. These 5 cases are the focus of the present report. Their mean age was 48.6 years (range 25–65 years), with a male preponderance (80%). The most common clinical onset was headache, present in 4 patients. Other associated symptoms were vertigo (n = 2), short-term memory loss (n = 1), ataxia (n = 1), and incontinence (n = 1). One patient was in a comatose state brought on by severe acute hydrocephalus. All patients underwent pre-operative radiological evaluation in which CT scanning and MRI were performed. Ventriculomegaly, defined as an Evan’s ratio of at least 0.30, was present in all cases (Table 1).

**Operative Technique**

Under general anesthesia the patient is positioned supine with the head resting in the neutral position. After a short linear precoronal-coronal skin incision is made, a bur hole is performed, 1 cm in front of the coronal suture and 2–3 cm lateral to the midline. The bur hole is then beveled by drill or rongeur to enhance angulation of the endoscope. A right-sided approach is preferred unless the right ventricle is too small to be used for an endoscopic endoscope. Freehand ventricular puncture is performed, and the parenchymal corridor produced by the ventricular catheter is used to introduce the endoscope in the lateral and the parenchymal corridor produced by the ventricular catheter is used to introduce the endoscope in the lateral
ventricle. After inserting the rigid endoscope with a 0° lens (Karl Storz GmbH & Co.), irrigation is started to improve visualization of the surgical field, and the anatomical landmarks (septum pellucidum, thalamostriate vein, anterior septal vein, choroid plexus, foramen of Monro) are recognized as well as the surface of the cyst, which usually protrudes through the foramen of Monro into the ipsilateral ventricle (Fig. 1A and B). The resection begins through the foramen when the surgeon coagulates and opens the cyst wall for an initial intracapsular debulking. At this point, a Fogarty balloon is inserted into the cyst and inflated to enlarge the opening and facilitate the removal of the cyst contents by aspiration or, if viscous, using grasping forceps. Once the cyst has been emptied, the capsule is resected in a piecemeal fashion through the foramen, attempting to remove its attachment point from the tela choroidea.

However, in 5 of our 19 cases, the colloid cyst was firmly adherent to the tela choroidea or attached to the middle/posterior roof of the third ventricle, making the transforaminal route unsafe for completely resecting the capsule because visualization of its insertion site was not adequate. To obtain a better exposure of the roof of the third ventricle and a more posterior access to the colloid cyst, the choroidal fissure was opened, staying medial to the choroid plexus and passing through the tela fornicis. One of the main limits of this approach was the difficulty of translating into endoscopy the bimanual dissection used in conventional microneurosurgery. However, a sort of bimanual dissection was performed using scissors, bipolar coagulator, or the tip of a deflated Fogarty catheter as a dissector and a cut Fogarty catheter as a rigid aspirator, simultaneously exploiting both working channels of the endoscope. In this way the choroid plexus was lateralized and the choroidal fissure opened. The choroidal fissure is anteriorly opened up to the anterior septal vein, which is usually not sacrificed and constitutes the watershed between the anterior transchoroidal and the posterior transchoroidal corridors. The posterior septal vein represents the posterior limit of the fissure opening because it corresponds to the point where the third ventricle ends and the thalamus becomes indistinguishable from the body of the fornix.

**TABLE 1: Characteristics of patients with third ventricle colloid cysts treated by the combined ETTA**

<table>
<thead>
<tr>
<th>Age (yrs), Sex</th>
<th>Symptoms at Admission</th>
<th>Ventricular Dilation</th>
<th>Cyst Diameter on MRI</th>
<th>Residual Capsule</th>
<th>Complication</th>
<th>ETV/ Septostomy</th>
<th>Shunt Dependence</th>
<th>Follow-Up (mos)</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>51, F</td>
<td>headache, vertigo</td>
<td>enlargement of lt lat ventricle</td>
<td>33 mm</td>
<td>no</td>
<td>no</td>
<td>no/no</td>
<td>no</td>
<td>64</td>
<td>no</td>
</tr>
<tr>
<td>65, M</td>
<td>headache, vertigo vomiting</td>
<td>biventricular occlusive hydrocephalus</td>
<td>30 mm</td>
<td>no</td>
<td>transient memory deficit</td>
<td>no/yes</td>
<td>no</td>
<td>73</td>
<td>no</td>
</tr>
<tr>
<td>39, M</td>
<td>headache, somnolence, ataxia, incontinence</td>
<td>biventricular occlusive hydrocephalus</td>
<td>23 mm</td>
<td>no</td>
<td>yes/yes</td>
<td>no</td>
<td>84</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>62, M</td>
<td>coma</td>
<td>extensive enlargement of rt lat ventricle</td>
<td>21 mm</td>
<td>no</td>
<td>no</td>
<td>no/yes</td>
<td>no</td>
<td>42</td>
<td>no</td>
</tr>
<tr>
<td>25, M</td>
<td>positional headache, short-term memory loss</td>
<td>biventricular occlusive hydrocephalus</td>
<td>25 mm</td>
<td>no</td>
<td>yes/yes</td>
<td>no</td>
<td>79</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

*ETV = endoscopic third ventriculostomy.*
Resection of colloid cysts using the ETTA

However, this posterior exposure was rarely necessary because the cyst, in growing, had already created enough space to make holes in the capsule that allow its deflation and progressive removal. The gradual insufflation of the Fogarty catheter or the alternating opening and closing of the forceps was used to gently separate the choroid plexus from the fornix, thus expanding the surgical corridor. At this point, the superior membrane of the tela choroidea was opened and the contents of the velum interpositum (medial posterior choroidal arteries and internal cerebral veins) were seen. The ipsilateral internal cerebral vein and the branches of the medial posterior choroidal artery were gently mobilized to reach the inferior membrane of the tela choroidea without sacrificing any vascular structure. The dissection was mainly performed bluntly because the tumor had already stretched the choroid plexus; however, in relation to the needs of the case, sharp dissection of the small fibrous branches of the tenia fornici and coagulation of small vessels of the velum interpositum were used as well. Once the inferior membrane of the tela choroidea was opened, the posterior portion of the cyst and its attachment to the tela choroidea were fully exposed, allowing the safe detachment of the capsule from the roof of the third ventricle (Fig. 1C and D). Finally, the capsule was gently pushed anteriorly so that it could be removed through the foramen of Monro or through the larger transcortical trans–velum interpositum port (Fig. 2). Once the colloid cyst was completely removed, the third ventricle was carefully inspected to confirm that there were no residual fragments and no aqueductal obstructions by viscous contents of the cyst. A third ventriculocisternostomy was performed in those cases in which synechiae inside the sylvian aqueduct and blood present at the end of the procedure put the patient at risk for acute hydrocephalus. A septostomy was performed when there was suspicion of a concomitant adherence of the capsule to the contralateral choroid plexus, thalamostriate/septal veins, or anterior column of the fornix. In these cases, septostomy allowed the surgeon to explore the opposite ventricle and eventually separate the residual capsule from the contralateral structures, thus making the removal safer. This additional procedure, which was quite often carried out to enlarge a preexisting hole in the septum, ensured a total removal of the tumor in 2 of the 4 cases in which the septostomy was performed.

Results

The average length of the operation was 140 minutes. Hospital stays did not exceed 6 days in any but one patient who was sedated and intubated before surgery because of acute hydrocephalus and required postoperative intensive care unit support. In this patient, an external ventricular drain was left in place at the end of the procedure and it was removed 5 days later without development of postoperative shunt dependence. The patient was discharged to home 12 days after surgery. In the remaining cases, hydrocephalus resolved spontaneously after we removed the colloid cyst, and there was no need for external ventricular drainage or placement of a ventriculoperitoneal shunt. No intraoperative complications occurred, and no endoscopic procedure was converted to an open craniotomy. Only one patient experienced a transient memory deficit, which completely resolved in 2 weeks. Intraoperative visual inspection and postoperative MRI documented a complete resection of the cyst, including its attachment to the tela choroidea, in all 5 patients (Figs. 3 and 4). Serial clinical evaluations (follow-up range 42–84 months, average 68.4 months) showed an improvement of the preoperative neurological status in all patients. Neuroradiological stud-
ies (MRI), at 6 and 12 months after surgery and annually thereafter, have documented no signs of cyst recurrence.

**Discussion**

Colloid cysts are histologically benign lesions whose primary goal of treatment should be complete resection for prevention of early or late recurrence and sudden death.2–4,6,8–10,12,14,16,17,19–21,23,28,29,31,32 Stereotactic aspiration of colloid cysts was developed as a minimally invasive procedure that improves the symptoms related to cyst growth by deflating the lesion.3,12,17,28 Although this procedure is associated with low morbidity rates and is initially effective, the remaining cyst wall can continue to secrete cyst contents, decreasing the long-term efficacy of this technique.1,11

Open surgery is traditionally considered the gold standard for the treatment of third ventricle colloid cysts, with many authors having reported a residual/recurrence rate ranging from 0% to 1.1% when using a transcallosal or transfrontal-transventricular approach.5,6,8,10,13,18,19,26 However, these approaches have high operative morbidity and mortality rates because they are potentially associated with disabling complications such as venous infarction, hemiparesis, memory deficit, subdural hematoma, meningitis, and ventriculitis.5,6,13,19,26 Taking these results into consideration, alternative options for the treatment of these lesions were investigated.

The first report of endoscopic aspiration of a colloid cyst dates back to a paper published in 1983 by Powell et al.23 Since then, the use of endoscopy, and the interest in this method, has been increasing exponentially, as witnessed by the number of articles published in the last 2 decades.2–4,6,8–10,12,14,16,17,19–21,23,28,29,31,32 Several series have demonstrated the efficacy and safety of endoscopic resec-

![Fig. 3. Preoperative (A and B) and postoperative (C and D) T1-weighted MR images showing a colloid cyst attached to the middle/posterior roof of the third ventricle that was completely resected using a combined ETTA.](image1)

![Fig. 4. Preoperative (A and B) and postoperative (C and D) T1-weighted MR images revealing a third ventricle colloid cyst that was found intraoperatively to be firmly adherent to the tela chooroidea and was thus removed using a combined ETTA.](image2)
men of Monro. This is the reason why we prefer to add the transchoroidal route to the transfornaminal approach in all cases in which the cyst firmly adheres to the tela choroidea or the site of insertion is in the middle/posterior roof of the third ventricle. In fact, the combined ET TA provides a complete exposure of the cyst and a better visualization of the tela choroidea, allowing the capsule to be safely detached from the third ventricle roof and increasing the chances for a total resection. Moreover, ensuring a dual access to the third ventricle, the ET TA allows not only the complete exposure of the cyst but also full control of the vessels crossing from the cyst to the ventricular structures that are sometimes responsible for serious intraventricular bleeding. Additionally, this dual-route technique offers two different corridors through which the cyst can be manipulated and removed, reducing the traction on the foramen of Monro and avoiding the excessive traumatization of the fornix. Again, the use of a transchoroidal route does not potentially increase the risk of neurological complications because it takes advantage of a natural corridor that exists between the third and lateral ventricles. In fact, because the choroidal fissure is the thinnest site in the wall of the lateral ventricle, where there is no neuronal tissue interposed between the lateral and third ventricles, it can be safely opened to connect the two ventricles.

Some authors advocate the use of a more anteriorly located bur hole (just behind the hair line) and the use of a 30° scope as an alternative to opening the choroid fissure to access the colloid cysts of the posterior third ventricle. It was our experience that the use of this approach for these posteriorly located lesions can cause contusions on the anterior column of the fornix or a bleeding at the junction of the choroid plexus, thalamostriate vein, and septal vein. This is probably due to the angulation of approximately 20° of the foramen of Monro from the sagittal plane, which requires the surgeon to force the endoscope medially for complete visualization and dissection of the lesion, thus exposing the anterior column of the fornix and the veins to unwanted damage.

Conclusions

It could be argued that total resection of the cyst capsule is necessary. However, when feasible, complete resection of benign lesions should be the goal of surgery, especially of colloid cysts in young patients in whom the risk of recurrence and sudden death is considerable. Although several studies have addressed the controversy between open microsurgical and endoscopic resection of colloid cysts, the issue has not been completely resolved. To summarize, endoscopy seems to be associated with a lower rate of complications but a higher rate of incomplete resection. The rationale of combining the transchoroidal and the transfornaminal approaches during endoscopic surgery for colloid cysts is to increase the chances of total tumor resection while maintaining the minimized invasiveness of this technique, even in cases of cysts attached to the middle/posterior roof of the third ventricle or firmly adherent to the tela choroidea. To our knowledge, there are few reports on the use of the choroidal fissure as a route to access the third ventricle, and we have highlighted how this approach could be performed not only microsurgically but also endoscopically. Long-term follow-up will be required to determine whether the ET TA is equivalent to craniotomy procedures or superior to pure transfornaminal endoscopic approaches in terms of safety and colloid cyst recurrence.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Iacoangeli, Nasi, Scerrati. Acquisition of data: di Somma, Di Rienzo, Alvaro, Nasi. Analysis and interpretation of data: di Somma, Alvaro, Nasi. Drafting the article: Iacoangeli, Alvaro, Nasi, Scerrati. Critically revising the article: Iacoangeli, Di Rienzo, Scerrati. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Iacoangeli. Study supervision: Iacoangeli, Scerrati.

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