Endoscopic resection of incidental colloid cysts

Clinical article

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Object. Incidental colloid cysts are frequently managed with surveillance imaging rather than surgical excision. This approach is born out of their purported indolent growth pattern and the surgical morbidity associated with microsurgical removal. The advent of endoscopic colloid cyst removal may offer renewed assessment of these patients who carry a risk of acute neurological deterioration. An evidence-based recommendation should weigh the risks of operative treatment. Thus far, there has been no concentrated assessment of cyst removal in patients with incidental colloid cysts. The major objective in this study was to define the risks associated with the endoscopic surgical removal of incidentally diagnosed colloid cysts.

Methods. A retrospective review of the medical records was performed to search for patients evaluated for a colloid cyst between the years 1996 and 2012. Eighty-seven patients underwent colloid cyst resection, and 34 were managed with nonoperative surveillance imaging. Microsurgical resections, endoscopic resections of residual or recurrent colloid cysts, and cases with unknown preoperative symptomatic status were excluded from further analysis. Seventy-seven cases of primary endoscopic resections were identified. Twenty resections were performed in patients with an incidental diagnosis and 57 in symptomatic individuals. Presenting characteristics and surgical outcomes were compared between the incidental and symptomatic groups.

Results. The mean age at surgery was 39.65 years for the incidental and 43.31 years for the symptomatic group (p = 0.36). The median maximal cyst diameter was 9.7 mm (range 3–31 mm) for the incidental and 12 mm (range 5–34 mm) for the symptomatic group. The mean frontal and occipital horn ratio was 0.3928 for the incidental and 0.4445 for the symptomatic group (p = 0.002). Total resection was achieved in 90% of the incidental and 82.3% of the symptomatic cases (p = 0.49). The median hospital stay was 1 day for incidental and 2 days for symptomatic cases (p = 0.006). There were no deaths. There was one case of aseptic meningitis in the incidental group. In the symptomatic group there were 3 complications: one patient with subjective memory impairment, one with transient short-term memory deterioration, and another with a superficial wound infection treated with operative debridement. Two patients from the symptomatic group needed a CSF diversion procedure, and no shunting was needed in the incidental group. There were two recurrences in the symptomatic group (78 and 133 months postoperatively) and none in the incidental group (p = 1).

Conclusions. Age and cyst diameter were not correlated with the absence or presence of symptoms in patients with a colloid cyst of the third ventricle. Operative results were highly favorable in both groups and did not reveal a higher risk of morbidity in the patient presenting with an incidental lesion. The results support endoscopic resection as a legitimate therapeutic option for patients with incidental colloid cysts. Generalization of the operative results should be cautiously made, since this is a limited series and the results may depend on the degree of neuroendoscopic experience.

(http://thejns.org/doi/abs/10.3171/2014.3.JNS131289)

Key Words • neuroendoscopy • colloid cyst • asymptomatic disease • incidental finding • third ventricle • treatment outcome • oncology

Symptomatic colloid cysts are notorious for their propensity to lead to acute neurological deterioration, permanent neurological impairment, or death. Such risks favor operative treatment. However, incidental colloid cysts are considered to have a more indolent course, and the trend is toward observation with surveillance imaging rather than operative treatment. As a result, limited data are available regarding operative outcome in patients with incidental colloid cysts, a deficiency that makes the decision-making process arbitrary and problematic. Ideally, decisions would be made based on factual information comparing the risks of observation with operative treatment. Thus far, there has been no concentrated assessment of cyst removal in patients with incidental colloid cysts. The major objective in this study was to define the risks associated with the endoscopic surgical removal of incidentally diagnosed colloid cysts. An evidence-based recommendation should weigh the risks of operative treatment. In the incidental group, there were two recurrences (78 and 133 months postoperatively) and none in the incidental group (p = 1).

Conclusions. Age and cyst diameter were not correlated with the absence or presence of symptoms in patients with a colloid cyst of the third ventricle. Operative results were highly favorable in both groups and did not reveal a higher risk of morbidity in the patient presenting with an incidental lesion. The results support endoscopic resection as a legitimate therapeutic option for patients with incidental colloid cysts. Generalization of the operative results should be cautiously made, since this is a limited series and the results may depend on the degree of neuroendoscopic experience.

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Abbreviations used in this paper: ENT = ear nose and throat; EVD = external ventricular drain; FOR = frontal and occipital horn ratio.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.
follow-up MR images were assessed for recurrence. The postoperative period was measured in months, and it included different measures for clinical and brain MRI follow-up. The presence of complications, recurrences, and shunt dependency were also recorded. The follow-up remnants remained in situ. Complications, recurrences, and missing detailed data on the preoperative symptom status. Treatment options for this specific population had been discussed, emphasizing either continued observation with serial MRI or endoscopic removal. Therapeutic plans had been decided after an informed discussion with the patient pertaining to the relative risks and potential benefits of surgery. A relatively younger patient (age < 50 years), larger cyst size (> 10 mm), or evidence of cyst growth were all features that prompted recommendation for surgery over purposeful observation. In the absence of any of these parameters, decisions rested solely on patient preference. The institutional review board at Weill Cornell Medical College approved the conduction of this study, and informed consent was obtained.

Methods

Patient Population

A retrospective review of the medical records was performed to search for patients evaluated for colloid cyst between 1996 and September 2012. Eighty-seven patients had been submitted to colloid cyst resection, and 34 had been managed with surveillance monitoring. From the operative cohort, we identified those patients who had undergone a primary endoscopic colloid cyst resection. Exclusion criteria for the study were secondary resections of residual or recurrent colloid cysts, open microsurgical resections, and missing detailed data on the preoperative symptom status.

Parameters Under Study

We noted the age and sex of patients at the time of surgery and the indication for neuroimaging. We recorded the preoperative presence of hydrocephalus based on the quantitative measure of the ventriculomegaly: Evans ratio and frontal and occipital horn ratio (FOR).

The maximum cyst diameter was measured based on the preoperative brain imaging study. The utilization of stereotaxy, the side of the operative approach, the postoperative use of an external ventricular drain (EVD), and the length of the hospital stay were also recorded. Resection was classified as total if there was no endoscopic evidence of residual cyst on completion of the surgery. Alternatively, resection was classified as subtotal when coagulated cyst wall remnants remained in situ. Complications, recurrences, and shunt dependency were also recorded. The follow-up period was measured in months, and it included different measures for clinical and brain MRI follow-up. The follow-up MR images were assessed for recurrence.

Definition of Incidental Colloid Cysts

Incidental findings were defined as “findings that are unrelated to the clinical indication for the imaging examination performed.”

Headache is the most common symptom in colloid cysts. Given the presence of neuroimaging criteria for headache and the above definition, a colloid cyst associated with headache was considered symptomatic if the patient met the neuroimaging criteria (Criterion 1; Table 1). Chronic headache (mainly migraine and tension type) is prevalent in the general population, and typical migraine and tension type headaches do not usually require neuroimaging. Therefore, typical migraine or tension type headache in patients with colloid cyst did not preclude the definition of incidental. The presence of symptoms that have been traditionally associated with the presence of colloid cysts qualified the case as symptomatic (Criteria 2–3).

Endoscopic Technique

All procedures were performed with the patient under general endotracheal anesthesia. Intravenous antibiotic prophylaxis and perioperative intravenous steroids were administered, but seizure prophylaxis was not. Patients were supine with 30° of head elevation to minimize CSF egress. A 0° or 30° rigid lens endoscope (MINOP, Nico Corp.) was used for all procedures. The endoscope was used in conjunction with an endoscopic sheath that had an outside diameter of 6 mm and a 2-mm working channel. A precoronal entry point was selected based on the preoperative stereotactic plan. Stereotaxy was preferentially used to determine an optimal trajectory between the head of the caudate nucleus and the column of the fornix using a far frontal entry site. Early on in our experience, stereotaxy was used only in patients with small ventricles, but its application was later expanded to all cases. A modified transcavum-interforniceal approach was used when the cyst was located within a cystic cavum or within the leaflets of the septum pellucidum. In some cases the cyst could be separated from the roof of the third ventricle and was removed en bloc.

The cyst membranes were dissected using a rotating torsion maneuver to draw the cyst wall perpendicularly away from the third ventricular roof. If cyst wall remnants were deemed too adherent to surrounding structures, they were thoroughly coagulated. Since recurrence has been correlated with cyst remnants, surgical intent was total cyst removal. In situations in which the cyst had a mineralized core, a tissue-shaving device was used (Nico Myriad, Nico Corp.). No septostomy was performed. The decision to insert an EVD was individualized based on the degree of intraoperative bleeding as well as direct endoscopic inspection of the third ventricle and cerebral aqueduct at the completion of the surgical procedure.

Statistical Analysis

The values of pre- and postoperative parameters in the incidental and symptomatic groups were summarized by descriptive statistics (including mean, standard deviation, median, range, frequency, and percent). Preoperative and postoperative variables were compared between the incidental and symptomatic groups using the independent samples t-test (or Wilcoxon rank-sum test) for continuous variables and the chi-square test (or Fisher’s exact test) for categorical variables. Fisher’s exact test and 1-way ANOVA were used for comparisons among patients with operated incidental, operated symptomatic, nonoperated incidental, and nonoperated symptomatic colloid cysts. To assess the precision of the obtained estimates, 95% confidence intervals were calculated.

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TABLE 1: Incidental colloid cyst criteria used in current study

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>absence of headache that meets criteria for neuroimaging:&lt;sup&gt;a&lt;/sup&gt; “headache &amp; an unexplained abnormal finding on the neurological examination” “headache worsened by Valsalva maneuver, headache causing awakening from sleep, new headache in the older population, or progressively worsening headache” atypical migraine or atypical, mild chronic tension-type headache</td>
</tr>
<tr>
<td>2</td>
<td>absence of headache w/ characters typically associated w/ colloid cysts: postural component associated w/ nausea/vomiting associated w/ memory impairment</td>
</tr>
<tr>
<td>3</td>
<td>absence of any episode of consciousness impairment that cannot be directly attributed to an irrelevant cause</td>
</tr>
</tbody>
</table>

Results

Eighty-seven patients had undergone colloid cyst resection. Seventy-seven primary endoscopic resections were included in the study, and 10 cases were excluded: 4 cases of microsurgical removal, 5 cases of secondary resection for residual or recurrent disease (primary resections at other hospitals), and 1 case with a preoperative status that could not be accurately defined. Twenty (25.97%) of the 77 cases were incidental and 57 (74.03%) were symptomatic. In addition to the surgically treated colloid cysts, we identified 13 symptomatic and 21 incidentally discovered colloid cysts in patients who opted for a nonoperative management with serial neuroimaging.

Patient Presentation

Table 2 contains clinical information on the patients with incidental colloid cysts. Table 3 lists the summary statistics for the two groups, that is, those with incidental and those with symptomatic colloid cysts managed with resection, and the results of statistical comparisons between the two groups. The mean age at the time of surgery was 39.7 years (range 12–69 years) for the incidental and 43.3 years (range 11–81 years) for the symptomatic group. There were 10 males and 10 females (50%) in the incidental group, while in the symptomatic group there were 28 males (49.1%) and 29 females (50.9%). In the symptomatic group, 17 patients (29.8%) presented acutely, while 40 (70.1%) had chronic symptoms. In the incidental group the colloid cyst was diagnosed following imaging for impact-related trauma in 8 cases, ear nose and throat (ENT) evaluations in 4 cases, and various other etiologies in the remaining 8 cases (Table 2). The median maximal cyst diameter was 9.7 mm (range 3–31 mm) for the incidental and 12 mm (range 5–34 mm) for the symptomatic group. The differences in the mean preoperative Evans ratio and FOR were statistically significant (p < 0.0001 and p = 0.0002, respectively). The mean preoperative Evans ratio was 0.2855 for the incidental group and 0.3409 for the symptomatic group (ventriculomegaly if ratio ≥ 0.3). The mean preoperative FOR was 0.3928 for the incidental and 0.4445 for the symptomatic group (normal value 0.37<sup>b</sup>). Figure 1 depicts typical imaging findings of an incidental colloid cyst.

The 21 patients with the incidentally discovered colloid cysts who elected to undergo serial neuroimaging with potential surgical intervention in the event of any symptom generation or radiological deterioration had, at the time of diagnosis, a mean age of 37 years (range 11–75 years) and a mean cyst diameter of 7.7 mm (range 3–18 mm). This patient population consisted of 11 females (52%) and 10 males (48%) and included 3 patients with ventriculomegaly. The mean clinical and radiological follow-up time was 34.6 and 34 months, respectively. The 13 patients (11 females [85%] and 2 males [15%]) with symptomatic colloid cysts who opted for serial neuroimaging had a mean age of 36 years (range 13–79 years), a mean maximal cyst diameter of 7.3 mm (range 5–13 mm), a mean clinical and radiological follow-up of 50 months, and only 1 case of ventriculomegaly.

It is noteworthy that the group with symptomatic, surgically treated colloid cysts included a patient with an incidentally discovered colloid cyst that remained asymptomatic for 17 years until he developed headaches and short-term memory loss and underwent endoscopic resection. Twenty (49%) of the 41 individuals with incidental colloid cysts chose to undergo operative treatment, compared with 57 (81%) of the 70 patients with symptomatic colloid cysts (p < 0.001). Among all 4 groups of patients (operated incidental, operated symptomatic, nonoperated incidental, and nonoperated symptomatic colloid cysts), there was no statistically significant difference in mean age (p = 0.289), sex (p = 0.154), radiological follow-up (p = 0.213), or clinical follow-up (p = 0.369). The surgically treated symptomatic group had a mean maximal colloid cyst diameter that was larger than the respective values for the incidental and symptomatic nonoperated groups, and this difference in diameter was statistically significant (p = 0.001 and 0.004, respectively), while the difference in diameter compared with the operated incidental colloid cysts was not (p = 0.157).

Operative Details and Outcome

Table 3 summarizes the operative and outcome data. Stereotactic navigation has been used for all cases since 2003.
2001. A left-sided approach was selected in 42.1% of incidental and 11.8% of symptomatic cases. One patient with a large, symptomatic calcified cyst needed a bilateral approach. In another symptomatic patient, a switch was made to an open procedure because of intraventricular bleeding. The bleeding was not threatening; nevertheless, it did obscure visualization of the operative site. The open resection was completed without any adverse sequelae. Coagulated cyst remnants were believed to be present in only 10% of incidental and 17.6% of symptomatic cases. An EVD was needed in 20% of incidental and 51% of symptomatic cases. The median hospital stay was 1 day for incidental cases (mean 1.8 days, range 1–8 days) and 2 days for symptomatic cases (mean 4.3 days, range 1–23 days). Two patients (3.5%) from the symptomatic group needed a shunt procedure. Repeated attempts at weaning one symptomatic patient from the EVD failed, and the patient was taken to surgery for a planned endoscopic inspection and possible shunt placement. Intraoperatively, a hematoma obstructing the foramen of Monro was removed. The patient was discharged 2 days later in excellent condition and remains shunt free. There were 2 recurrences (3.5%) in the symptomatic group (78 and 133 months postoperatively) and none in the incidental group. It is notable that both recurrences happened subsequent to subtotal resections that had been performed early in our series. Both recurrences were asymptomatic, and endoscopic re-resection was performed uneventfully. The postoperative recommendation to patients was to follow-up with annual MRI studies to rule out any recurrence. However, some patients presented for follow-up without an updated MRI study, and this led to a difference between the mean radiological (MRI) and mean clinical follow-up time. The mean MRI follow-up period was 18 ± 18.7 months for the incidental group and 39.7 ± 38.1 months for the symptomatic group. The mean clinical follow-up period was 23 ± 24.4 months for the incidental group and 42.5 ± 37.5 months for the symptomatic group.

### Procedural Complications

No mortality was associated with the procedure. Three complications were noted in the symptomatic group and one in the incidental group. One patient in the symptomatic cohort suffered a superficial wound infec-

<table>
<thead>
<tr>
<th>TABLE 2: Characteristics of patients with incidental colloid cysts*</th>
</tr>
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<tbody>
<tr>
<td><strong>Sex/Age at Surgery (yrs)</strong></td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>F/29</td>
</tr>
<tr>
<td>F/45</td>
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<tr>
<td>M/44</td>
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<tr>
<td>F/13</td>
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<tr>
<td>M/23</td>
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<tr>
<td>F/45</td>
</tr>
<tr>
<td>M/51</td>
</tr>
<tr>
<td>M/20†</td>
</tr>
<tr>
<td>F/45</td>
</tr>
<tr>
<td>M/35</td>
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<tr>
<td>F/47</td>
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<tr>
<td>M/38</td>
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<tr>
<td>M/47</td>
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<tr>
<td>M/49</td>
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<tr>
<td>M/42</td>
</tr>
<tr>
<td>F/37†</td>
</tr>
<tr>
<td>F/60</td>
</tr>
<tr>
<td>M/12</td>
</tr>
<tr>
<td>F/69</td>
</tr>
<tr>
<td>F/42</td>
</tr>
</tbody>
</table>

* Stereotaxy was used in all patients. No patients had a recurrence or shunt dependency. FU = follow-up; + = yes; – = no.† Only complication of aseptic meningitis occurred in this patient.‡ Missing data.
tion that needed operative debridement. Additionally, one patient with a psychiatric history of anxiety disorder complained of short-term memory problems, although they did not prevent her from continuing her usual occupation as a teaching assistant. One more patient who had depression and memory issues in the preoperative period complained of short-term memory deterioration in the first few postoperative weeks. She returned to her work as a realtor, and formal memory testing in the 5th postoperative month revealed that she was in the high average range. In the incidental group, there was one case of aseptic meningitis in the postoperative period. The patient was readmitted on the 5th postoperative day, hospitalized for 2 days, and fully recovered after receiving a short course of steroid treatment.

### Discussion

Our study indicated that excellent operative results can be achieved with the endoscopic resection of incidental colloid cysts. Moreover, a comparison of incidental and symptomatic cysts shows that limited differences exist between these two categories in terms of both the preoperative parameters and the operative results. In fact, patients with incidentally diagnosed colloid cysts tend to have a shorter hospital stay, greater likelihood of total removal, fewer complications, less need for a postoperative EVD, and lower rate of recurrence than those with symptoms. These findings counter the hypothesis that surgical morbidity would be greater in the patient with incidental colloid cysts given the smaller ventricular size and normal functional status. Similarly, one would also hypothesize that the extent of endoscopic removal would be lower in the patient with an incidentally diagnosed colloid cyst given the greater technical demands.

The threshold for brain imaging studies is continuously being lowered. For example, in Norway the number of MRI studies doubled from 2002 to 2008. This trend is expected to further increase the discovery rate of incidental colloid cysts. The management of incidental colloid cysts entails two options: observation and surgical treatment. The latter consists of either craniotomy for microsurgical removal or endoscopic removal. Systematic reviews as well as direct comparisons of the two methods have shown that endoscopic resection offers a significantly lower rate of complications and postoperative shunt dependency. This reduction in the risk profile associated with endoscopic removal justifies renewed assessment regarding the management of incidental lesions.

We opted to study the incidental rather than the asymptomatic colloid cysts because we believed it was difficult to accurately define what constitutes an asymptomatic colloid cyst when headaches were present. To make the classification more objective, we decided to use some of the neuroimaging criteria for headache as a threshold to classify a colloid cyst as symptomatic. This approach can overcome any classification inaccuracies that may arise in study populations with different levels of access to neuroimaging studies.

### Literature Review

Given the rarity of colloid cysts and the current tendency for nonoperative management, there has been no systematic assessment of patients with incidental lesions. The first case was published by the senior author in 2005, and this case was included in the current case

### TABLE 3: Comparison of incidental and symptomatic colloid cyst cohorts

<table>
<thead>
<tr>
<th>Parameter (no. of incidental/symptomatic patients included in analysis; data missing in the remainder)</th>
<th>Incidental Group</th>
<th>Symptomatic Group</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>total no. of patients</td>
<td>20</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>sex (20/57)</td>
<td>10 M, 10 F</td>
<td>28 M, 29 F</td>
<td>0.84</td>
</tr>
<tr>
<td>mean age at the time of surgery (20/57)</td>
<td>39.65 ± 14.5</td>
<td>43.31 ± 15.7</td>
<td>0.36</td>
</tr>
<tr>
<td>mean preop Evans ratio (19/51)</td>
<td>0.2855 ± 0.0417</td>
<td>0.3409 ± 0.0564</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>mean preop FOR (19/51)</td>
<td>0.3928 ± 0.0432</td>
<td>0.4445 ± 0.0532</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>mean max cyst diameter in mm (20/52)</td>
<td>11.2 ± 5.9</td>
<td>13.3 ± 5.5</td>
<td>0.157</td>
</tr>
<tr>
<td>patients w/ stereotactic approach (20/57)</td>
<td>20 (100%)</td>
<td>51 (89.5%)</td>
<td>0.18</td>
</tr>
<tr>
<td>patients w/ lt approach (19/51)</td>
<td>8 (42.1%)</td>
<td>6 (11.8%)†</td>
<td>0.008</td>
</tr>
<tr>
<td>patients w/ total resection (20/51)</td>
<td>18 (90%)</td>
<td>42 (82.4%)</td>
<td>0.49</td>
</tr>
<tr>
<td>patients w/ postop EVD (20/51)</td>
<td>4 (20%)</td>
<td>26 (51%)</td>
<td>0.03</td>
</tr>
<tr>
<td>median hospital stay in days &amp; range (19/49)</td>
<td>1, 1–8</td>
<td>2, 1–23</td>
<td>0.006</td>
</tr>
<tr>
<td>patients w/ complications (20/52)</td>
<td>1 (5%)</td>
<td>3 (6.7%)</td>
<td>1</td>
</tr>
<tr>
<td>median MRI FU in mos &amp; range (20/52)</td>
<td>8.5, 1–54</td>
<td>34.5, 1–159</td>
<td>0.016</td>
</tr>
<tr>
<td>median clinical FU in mos &amp; range (20/52)</td>
<td>11.5, 1–88</td>
<td>36, 1–159</td>
<td>0.0414</td>
</tr>
<tr>
<td>patients w/ recurrence (20/57)</td>
<td>0 (0%)</td>
<td>2 (3.5%)</td>
<td>1</td>
</tr>
<tr>
<td>patients w/ shunt dependency (20/57)</td>
<td>0 (0%)</td>
<td>2 (3.5%)‡</td>
<td>1</td>
</tr>
</tbody>
</table>

* Values expressed as means ± standard deviation, unless indicated otherwise. Boldface indicates significance.
† In addition: 1 switch to craniotomy, 1 bilateral approach.
‡ In addition: 1 endoscopic clot removal obviated a shunt placement.
Risks of Untreated Incidental Colloid Cysts

It is difficult to estimate the risk of acute neurologic deterioration in incidental colloid cysts. A literature review yielded several reports of a fatal outcome due to a colloid cyst following the acute onset of symptoms. Definitive estimation of the risk requires a prospective study with a sufficient number of patients with incidental colloid cysts that will allow for risk assessment in various age groups, a study that has not been performed thus far. A retrospective study showed that the risk for clinical progression was 8% in a 10-year follow-up interval. However, the mean patient age was 57 years, much older than the 29.6 years that was the mean age among 98 cases of colloid cysts with a fatal outcome and older than the mean age of 40 years among 78 patients in a population-based study. Further, in this often cited retrospective series, the rate of progression was based on a small subset of patients (14 of 58) that had an adequate duration (10 years) of follow-up. The patient group in that study may represent a subcategory with a more indolent form of this endoderm-derived developmental lesion, compared with more aggressive types that may present at younger ages. Nevertheless, even in this older patient group, radiological progression was noted in 6% of the patients at a mean follow-up of 41 months.

An estimation of the risk of untreated colloid cysts can be extrapolated from two previous population-based studies, although such an analysis has significant limitations. The first study is from the Netherlands and provides an indirect estimation of the prevalence of colloid cysts of 1 in 8500 persons. A recent meta-analysis of studies on incidental brain MRI findings identified 2 cases of colloid cysts in 15,559 people scanned, a number that supports the estimated prevalence rate in the former study. In the population of the Netherlands study (15,413,000 inhabitants), the prevalence of 1/8500 is translated to 1800 subjects who harbor undiscovered colloid cysts. Authors of the study collected clinical data on newly diagnosed colloid cysts in the aforementioned population and yielded 78 new cases over a 5-year period. Four of these cases were sudden deaths, and 21 cases were acute deteriorations with compromised consciousness that reached neuroimaging and neurosurgery consultation within 48 hours of acute symptom onset. In retrospect, most of these patients had some kind of symptom prior to the acute deterioration, but we assume that the symptoms at that time eluded the neuroimaging criteria and that a subsequent, early colloid cyst diagnosis was not made. The authors stated that there was unrestrained access to neuroimaging studies for the population, ruling out the possibility that a highly symptomatic patient did not have an early colloid cyst diagnosis because of neuroimaging access restraints. However, the neuroimaging indications applied by the medical community during the study period were not described. Given that the pre–acute phase symptoms in this group of patients did not lead to neuroimaging, the identification of a colloid cyst on a brain imaging study would qualify the finding of a colloid cyst as incidental. To calculate the incidence density of acute deterioration (leading to death or compromised consciousness) in incidental colloid cysts, we used the formula c/[Δt × (N –

Comparison of Presenting Characteristics

The lack of significant differences in cyst diameter between the incidental and symptomatic groups is rather counterintuitive, as symptoms would be expected to correlate with larger cysts. Importantly, the lack of significant differences in mean age and cyst diameter between incidental and symptomatic groups weakens the role of these parameters as prognostic criteria regarding which cyst will become symptomatic.

The differences in the mean Evans ratio and median FOR were statistically significant (greater in the symptomatic group). Increased intracranial pressure due to CSF flow obstruction is the commonly referenced mechanism for symptom production. However, in our series this mechanism appeared to be challenged by the presence of symptomatic patients without hydrocephalus and incidental cysts with concomitant ventriculomegaly. Intermittent obstruction or a noncompliant ventricular system can be proposed as an explanation for the presence of symptoms without hydrocephalus. Respectively, compensated hydrocephalus might explain asymptomatic ventriculomegaly in incidental cysts.

series. A previous report by Lewis et al. included an incidental colloid cyst, but it is unclear whether the cyst was treated by microsurgical removal or endoscopic resection. Ten additional cases were later reported as treated by microsurgical removal or endoscopic resection. A previous report by Lewis et al. included an incidental colloid cyst, but it is unclear whether the cyst was treated by microsurgical removal or endoscopic resection.

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c/2], where c is the number of cases, \( \Delta t \) is the time period of interest, and N is the number of persons at risk. The number of cases (c) is divided by 2 because the calculation assumes that the 25 cases developed deterioration around the midpoint of the follow-up period. The number of persons at risk would be the number of the colloid cyst carriers (1800) in the study population minus the number that had symptoms leading to neuroimaging and an early diagnosis of a colloid cyst (49), yielding a number of 1751 for N. Based on the above formula, the incidence density of death and/or acute deterioration should be \( 25/\left(15 \times (1751 – 25/2)\right) \) cases per 1000 person-years. The cumulative lifetime risk depends on the age of the patient. Based on the calculated incidence density, the cumulative lifetime risk in a 40 year old (the average age in our series) with an incidental colloid cyst would be 10.9% for an average lifespan of 78 years (Fig. 2).

In the second population-based study, Hernesniemi and Leivo\(^9\) reported 5 deaths and a total of 13 cases of acute neurological deterioration in a population of 870,000 over a 14.5-year period. An indirect estimation of the risk of acute deterioration in an incidental colloid cyst can be made by assuming that the prevalence of colloid cysts in this study population is the same as that previously calculated (1/8500). We deduced that all colloid cyst carriers were diagnosed if they had nonacute symptoms that fulfilled the neuroimaging criteria, since the authors stated that modern health care was available for the whole study population. Furthermore, in the 13 patients with acute deterioration, we assumed that an early diagnosis was not made because their symptomatic status—prior to acute deterioration—did not qualify for neuroimaging. This series of assumptions leads to an estimation of the incidence density of acute neurological deterioration of 13/[14.5 \times (102 – 27 – 13/2)] = 13.08 cases per 1000 person-years for a colloid cyst carrier with a symptomatic status that does not meet the criteria for neuroimaging. This incidence rate translates to a cumulative lifetime incidence of 49.7% for a 40 year old with an incidental colloid cyst and a lifespan of 78 years (Fig. 2). This study provided details about the final outcome of patients with acute deterioration. Five patients died, whereas 8 had a good or excellent outcome following operative treatment. We share the opinion of de Witt et al.\(^4\) that sudden deaths and acute neurological deterioration with consciousness impairment have common underlying pathophysiological mechanisms, and the distinction between the two is the timeliness of intervention. Based on this concept and the data from these two population-based studies, acute neurological deterioration carries a mortality rate from 31% (9 of 29) to 38.45% (5 of 13).

Management of Incidental Colloid Cysts

There is general consensus that a patient with a symptomatic colloid cyst should undergo operative treatment. The decision-making process for surgery for an incidental colloid cyst should weigh the risks of observation and endoscopic resection. In our opinion, microsurgical removal, while a legitimate therapeutic option in this setting, might withhold from the patient all the reported benefits of endoscopic removal. The results of our study show that endoscopic resection can be performed safely and should be the primary option for an incidental colloid cyst if surgery is considered. On the other hand, observation carries a risk that cannot be accurately calculated until prospective studies elucidate the issue; however, it is also a valid option, as is evidenced by the 21 patients under our care who are being monitored. The lack of reliable prognostic factors regarding which colloid cyst will become symptomatic, a feature highlighted in our current study, further complicates the option of observation. It has been shown that a fatal outcome can result from cysts as small as 0.8 cm in diameter and in an age range of 6 months to 79 years.\(^3\) Each patient should be informed of the risks of both management approaches, and if she or he opts for endoscopic resection, referral to a high-volume center should be strongly considered. A young age carries a higher lifetime risk and may support the resection option. The presence of hydrocephalus has been shown to correlate with neurological deterioration\(^2\) and should be considered as a relative indication for operative treatment. Pollock et al.\(^22\) suggested that increased T2 signal and an iso- and/or hypodense CT appearance of the colloid cyst probably reflect ongoing cyst expansion; therefore, these imaging characteristics may also be used as surgical indications. A cyst size over 10 mm is probably related to a higher rate of cyst-related symptoms.\(^22\)

While the current results demonstrate a negligible risk associated with the endoscopic removal of incidental colloid cysts, the outcome in patients who undergo such treatment is based on retrospective data retrieval with all the inherent limitations of such an analysis. Any generalization of the current results should presume an advanced level of familiarity with intraventricular endoscopic surgery and integration of contemporary adjuncts such as navigational guidance and tissue-shaving devices. Note...
that the recurrences in our series happened in our second and third cases, suggesting a probable methodological evolution that may have contributed to subtotal cyst resection in the patients in these cases. A valid comparison of recurrence rates is not currently possible because of the few occurrences and the short duration of follow-up. Given that the total resection of colloid cysts carries a minimal risk of recurrence (2.2%) and that total resection was achieved in 90% of the incidental cysts, it is logical to conclude that the short mean follow-up period does not obscure any significant recurrence risk. Additionally, the main determinant of outcome in this population is the perioperative risk, which has been shown to be negligible and in fact better than in patients presenting with symptoms and larger ventricles. On the contrary, the follow-up time in patients with incidental colloid cysts who are being monitored, although similar to that in the surgically treated cases, is too short for any conclusions about the natural history or safety of the observation approach. Deciding between surgery and observation in the case of incidental colloid cysts introduces patient and surgeon biases, which are inevitable in an informed-consent process.

It is important to note that for some incidental colloid cysts, it may be prudent to follow a nonoperative approach. This cohort would have higher surgical risks and/or a risk of neurological deterioration that is intuitively expected to be lower. The list of characteristics of the incidental colloid cyst for which a conservative approach is favorable remains to be validated by a high-powered multicenter study. The list of features that may play a role in the decision-making process includes surgical comorbidities, a posterior third ventricle roof location, an intrasellar location, a hyperdense appearance on CT, a hypointense signal on T2-weighted MRI, a cyst size < 1 cm, and an older age.

The lack of formal neurocognitive testing is another significant limitation of the current study. The typical neurological examination and history taking are inadequate to measure or even detect the neurocognitive deficits that may preexist (for example, because of hydrocephalus or compression of the fornices by the colloid cyst) or are caused by the surgical intervention. Of course, the ultimate decision regarding management for incidental colloid cysts should be reached only after a thorough informed consent process with the patient and/or the family. We believe that the current report contributes to a more accurate assessment that should be included in that discussion.

Conclusions

Existing evidence does not allow for solid recommendations on the management of a patient presenting with an incidental colloid cyst. However, current results validate endoscopic resection as a legitimate treatment option. This therapy removes the burden of a largely unknown risk of acute neurological deterioration by a procedure that in experienced hands appears to be safe and effective.

Disclosure

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