Ependymal cysts arise from displaced segments of the wall of the neural tube. These segments correspond to the sites from which the tela choroidea forms. Microscopic examination of the cyst wall discloses some variance in structure, of which the most common feature is a monolayer of ciliated cells sitting on a very thin collagen membrane. In some segments the ependymal lining cells assume a more typical cuboidal form, and cilia are not observed on the free surfaces. In general, CSF has a lower protein content than cyst fluid, which may be appreciated in some cases on MR imaging.1,2,18

Epithelium-lined cysts should be differentiated from traumatic or infectious pseudocystic lesions, arachnoid cysts, or expanding cerebral cysts (lacunae).3,8,10,19 Careful neuroradiological investigation is necessary to establish an accurate diagnosis and plan neurosurgical management.

Ependymal cysts lacking direct communication with the ventricular system or subarachnoid space have been reported infrequently in the literature. The majority of these lesions have been found in the supratentorial space.2,3,7,9,11,15,17,18,24 Cysts in the posterior fossa have been documented in the pons, the cerebellar hemisphere and vermis cerebelli, the quadrigeminal plate, and the midbrain.1,4,5,12,14,16,20,26,27

Neurological examination findings in patients with mesencephalic ependymal cysts comprise symptoms of occlusive hydrocephalus with headache, nausea, and vomiting or symptoms such as Parinaud syndrome, dizziness,
gait disturbance, or worsened memory. In terms of their clinical presentation, it is impossible to distinguish ependymal cysts from other paracollicular mass lesions.

Because of the intraparenchymatous location of these cysts, neural tissue has to be traversed before reaching the cyst cavity. Consequently, minimally invasive treatment is mandatory. The primary objective should be the establishment of a fistula to the ventricular system or subarachnoid space. Our own surgical procedure differs from others primarily in that we attempted to treat the cysts definitively wherever possible by a pure endoscopic or endoscope-assisted keyhole neurosurgical technique without shunting.

Methods

Patient Population and Preoperative Imaging

Between 1994 and 2006 at the Department of Neurosurgery, University of Mainz, 8 symptomatic patients (7 women and 1 man) underwent a pure endoscopic or endoscope-assisted neurosurgical fenestration of mesencephalic ependymal cysts. The patients’ ages ranged from 22 to 60 years with a mean age of 44 years (Table 1). All patients underwent MR imaging preoperatively (Table 2). Some also underwent CT scanning and dynamic CSF cine flow studies.

Surgical Strategy and Technique

Our surgical goal was to normalize CSF flow and to establish a permanent communication of the cyst cavity with the ventricle or the subarachnoid space. Because of the highly eloquent region in the midbrain, total resection of the cyst was not the goal of surgery. The selected method was a pure endoscopic or endoscope-assisted keyhole neurosurgical procedure without implanting a drain or shunt whenever possible.

The MR images were used to detect the exact anatomical localization of the cyst, the thinnest part of the cyst wall, and the direction of displacement of mesencephalic structures. For exact surgical planning the relation of the cyst to the third ventricle and the ambient cistern is decisive. An adequate communication to the CSF pathway must be also achievable.

We performed endoscopic surgery (manipulation through the endoscope) in 4 cases (Cases 2, 3, 5, and 6; Table 3) via a frontal bur hole trepanation. A rigid ventriculoscope (Wolf, Germany) was introduced through a transventricular, transforaminal approach. The widest diameter of the Monro foramen was approached by a coronal or precoronal and parasagittal bur hole trepanation, which allowed a direct view of the third ventricular floor. However, the target region in the dorsal part of the third ventricle cannot be reached by such an approach without manipulation of the fornix. Therefore, a more frontal bur hole was placed. With bipolar coagulation, blunt perforation, and Fogarty balloon dilation, a fenestration of the cyst was achieved (Fig. 1).

In the other 4 cases (Cases 1, 4, 7, and 8; Table 3) we performed endoscope-assisted microsurgery through an infratentorial supracerebellar approach. Under repetitive endoscopic inspection with a cystoscope (Wolf, Germany) or a MINOP lens scope (Aesculap, Germany) microsurgical dissection was performed. The goals of surgery were a cystocisternostomy as well as endoscopic fenestration of the cyst.

![Table 1](image1)

**Table 1**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs.), Sex</th>
<th>Main Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35, F</td>
<td>CN III palsy, headache, gait disturbance, vertigo, slight hemiparesis</td>
</tr>
<tr>
<td>2</td>
<td>53, F</td>
<td>Parinaud syndrome for 6 wks, gait disturbance, headache for several yrs, hemiparesis, facial palsy</td>
</tr>
<tr>
<td>3</td>
<td>54, F</td>
<td>vertigo, progressive headache, gait disturbance, lack of concentration</td>
</tr>
<tr>
<td>4</td>
<td>56, F</td>
<td>tinnitus, headache</td>
</tr>
<tr>
<td>5</td>
<td>60, F</td>
<td>headache, lt hemihypothalamic, lt hemiparesis, anosmia, gait disturbance</td>
</tr>
<tr>
<td>6</td>
<td>35, F</td>
<td>somnolence, headache, gait disturbance, diplopia, anosocoria (emergency care)</td>
</tr>
<tr>
<td>7</td>
<td>36, M</td>
<td>diplopia for 5 yrs, gait disturbance, incontinence, hearing loss</td>
</tr>
<tr>
<td>8</td>
<td>22, F</td>
<td>Parinaud syndrome, vertigo, double vision</td>
</tr>
</tbody>
</table>

* CN = cranial nerve.

![Table 2](image2)

**Table 2**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>MRI Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cystic lesion in the tectum of the mesencephalon (diameter 1.5 cm); occlusive hydrocephalus</td>
</tr>
<tr>
<td>2</td>
<td>cystic lesions of mesencephalon, lt thalamus, &amp; pons; occlusive hydrocephalus</td>
</tr>
<tr>
<td>3</td>
<td>several cysts of mesencephalon; aqueductal stenosis</td>
</tr>
<tr>
<td>4</td>
<td>cyst of mesencephalon w/ occlusive hydrocephalus</td>
</tr>
<tr>
<td>5</td>
<td>increasing cyst size, no sufficient drainage (op 6 yrs before; cystocisternal drainage through a median infratentorial supracerebellar approach because of mesencephalic/thalamic cyst)</td>
</tr>
<tr>
<td>6</td>
<td>cysts in rt mesencephalon/thalamus w/ consecutive hydrocephalus</td>
</tr>
<tr>
<td>7</td>
<td>cysts in lt thalamus &amp; mesencephalic cyst w/ occlusive hydrocephalus</td>
</tr>
<tr>
<td>8</td>
<td>mesencephalic cyst; no enlargement of ventricles (op 11 yrs before; pineal cyst, occipitomedial approach, VP shunt system)</td>
</tr>
</tbody>
</table>

![Table 3](image3)

**Table 3**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Op Approach</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>infratentorial supracerebellar</td>
<td>fenestration to the 3rd ventricle &amp; quadrigeminal cistern</td>
</tr>
<tr>
<td>2</td>
<td>transfrontal transfornaminal</td>
<td>cyst fenestration, biopsy, 3rd ventriculostomy</td>
</tr>
<tr>
<td>3</td>
<td>transfrontal transfornaminal</td>
<td>cyst fenestration, biopsy, 4 mos later 3rd ventriculostomy</td>
</tr>
<tr>
<td>4</td>
<td>infratentorial supracerebellar</td>
<td>cystocisternofenestration</td>
</tr>
<tr>
<td>5</td>
<td>transfrontal transfornaminal</td>
<td>cyst fenestration, 3rd ventriculostomy, 2nd op because of wound infection</td>
</tr>
<tr>
<td>6</td>
<td>infratentorial supracerebellar</td>
<td>cystocisternofenestration, partial resection</td>
</tr>
<tr>
<td>7</td>
<td>infratentorial supracerebellar</td>
<td>cystocisternofenestration, resection</td>
</tr>
</tbody>
</table>

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cystoventriculostomy to achieve a direct communication of the cyst with the third ventricle (Fig. 2).

Because of the risk of additional neurological deficits, a biopsy of the cyst was not performed routinely. However, a biopsy procedure was performed in patients in Cases 2, 3, 7, and 8. In all these cases, histological examination revealed an epithelium-lined cyst. The patients were discharged from the hospital in the 1st week after the surgery. They were all very satisfied with the cosmetic result of the surgical approach.

Results

Shortly after surgery all patients reported improvement in their headaches and neurological deficits. Four patients were symptom free (Cases 1, 2, 4, and 6), and the other 4 improved significantly after a mean follow-up duration of 38.5 months (range 5–119 months). Residual symptoms were headaches (Cases 3 and 5), gait disturbance (Case 7), and double vision (Case 8).

In all patients an adequate fenestration of the cyst into the ventricle or subarachnoid space was achieved. One patient (Case 3) underwent 2 operations: first a ventriculocystostomy and 4 months later third ventriculostomy because of recurrent hydrocephalus. In 1 patient (Case 6) a second surgery was necessary because of wound infection.

Illustrative Cases

Case 3

This 54-year-old woman was found to have 1 large and several small cysts in the mesencephalon reaching the thalamus. A lens scope was introduced via a frontal bur hole into the third ventricle through the left Monro foramen to attain a good view of the right thalamus and the typical landmarks: choroid plexus and interthalamic adhesion (Fig. 3c). A biopsy of the thalamic cyst wall was performed endoscopically, after which the cyst collapsed. There was no evidence of tumor (Fig. 3c and d). Postoperative MR images showed that the cysts collapsed (Fig. 3e and f).

Case 8

While abroad 11 years prior to presentation, this 22-year-old woman underwent an occipitomedial approach for a pinealis cyst. Because she had occlusive hydrocephalus, a VP shunt system was implanted. The MR images showed a mesencephalic cyst (Fig. 4a and b). Because there was a shunt in place, the ventricles were not enlarged. The patient underwent surgery in a prone position, and a medial suboccipital osteoplastic craniotomy was performed. (A cystoventriculostomy was also performed in this patient). After inspection with an endoscope (endoscope-assisted microsurgery), microsurgical dissection of the supracerebellar space and quadrigeminal cistern was performed. The cyst was opened microsurgically (Fig. 4c). Histological examination of the tissue within the cyst (Fig. 4d) revealed a granuloma of a foreign body from the first surgery. The MR imaging control studies revealed that the cyst had collapsed (Fig. 4e and f).

Case 7

This 36-year-old man was found to have cysts in the left thalamus and mesencephalon as well as occlusive hydrocephalus (Fig. 5a and b). Through an infratentorial supra cerebellar approach the cysts were opened using endoscopic assistance. Parts of the cysts were resected, and adequate fenestration to the third ventricle was performed. On the postoperative CT scans, the cysts were noted to have collapsed (Fig. 5c and d).

Discussion

Nontumorous cysts of the mesencephalon do not constitute a single pathological entity but rather a heterogeneous group of various cysts or pseudocystic lesions. Intraparenchymatous cysts of the mesencephalon have been reported infrequently and mostly as case reports. The diagnosis of a cyst is not always confirmed by histological examination and is often based only on clinical or
Fig. 3. Case 3. Images obtained in a patient who underwent a transfrontal, transforaminal approach. a and b: Preoperative T1-weighted MR images showing cysts in the mesencephalon. c and d: Images obtained with an endoscope during the biopsy, showing the aspect of the third ventricle interthalamic adhesion and choroid plexus. There was no evidence of tumor. e and f: Postoperative MR images showing collapse of the cysts.

Fig. 4. Case 8. Images obtained in a patient who underwent an infratentorial supracerebellar approach, microsurgical dissection of the quadrigeminal cistern, and opening of a mesencephalic cyst. a and b: Preoperative MR images showing a mesencephalic cyst. The inset shows the anatomical position of the sagittal section. c and d: Images obtained with an endoscope during the cystocisternoventriculostomy. e and f: Postoperative control MR imaging studies showing that the cyst had collapsed.
Neurosurgical treatment of cysts under keyhole conditions

The cyst should be reached surgically from the direction in which the wall of nervous tissue is the thinnest or where the least neurological deficits can be suspected. In this series of mesencephalic cysts a suboccipital supracerebellar approach in an endoscope-assisted microsurgical technique or a frontal approach over a bur hole in a pure endoscopic procedure were used. In all patients an adequate fenestration of the cyst was achieved without implanting foreign bodies. Although not all 8 patients became symptom free after undergoing surgery, all clearly improved clinically.

Asymptomatic cysts of the mesencephalon, which are incidental findings, should undergo control MR imaging. We recommend surgery for asymptomatic patients with hydrocephalus and enlarged ventricles.

Conclusions

Mesencephalic cysts can be treated successfully and most likely definitively by a pure endoscopic or endoscope-assisted microsurgical technique by use of the keyhole concept. There was no morbidity or mortality related to these procedures in this group of 8 patients. Because of these results we prefer the described surgical procedures and think that they are good alternatives to treatments such as shunt placement (VP and ventriculoatrial or cistocisternal) or stereotactic aspiration of the cysts.

Disclaimer

The authors do not report any conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Acknowledgment

We express our sincere appreciation to Stefan Kindel for the illustrations.

References


Fig. 5. Case 7. a and b: Preoperative MR images revealing a cyst in the left thalamus and mesencephalon, causing occlusive hydrocephalus. c and d: Postoperative control CT scans showing that cysts are collapsed.


Address correspondence to: Jens Conrad, M.D., Department of Neurosurgery, Johannes Gutenberg-University Mainz, Langenbeckstrasse 1, 55101 Mainz, Germany. email: jens_conrad@web.de.