Neuroendoscopic Transventricular Surgery for Suprasellar Cystic Mass Lesions Such as Cystic Craniopharyngioma and Rathke Cleft Cyst

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Abstract

Cystic mass lesions in the suprasellar cistern are often associated with neurological deficits, cognitive disorders, and endocrinological impairments. Many surgical approaches are available to treat these mass lesions, but are technically difficult and cannot remove the lesion completely without risking damage to neurological and endocrinological functions due to the proximity to the surrounding structures.

Neuroendoscopic transventricular surgery was performed using a ventricular fiberscope for three patients with craniopharyngiomas and two patients with Rathke cleft cysts, with gamma knife radiosurgery for craniopharyngiomas. The endoscopic transventricular approach is safe and minimally invasive for congenital benign suprasellar cystic lesions, especially arachnoid cysts.

Key words: neuroendoscopy, suprasellar cystic mass, transventricular approach

Introduction

Suprasellar cystic mass lesions, including craniopharyngiomas and Rathke cleft cysts, are generally resected through craniotomies or transsphenoidal surgical procedures. Partial resection of the cyst wall of Rathke cleft cysts with aspiration of the cyst contents is enough usually adequate to prevent recurrence but this management remains controversial for craniopharyngiomas.15) Total resection of craniopharyngiomas may be the optimal treatment, but most of these lesions adhere to the hypothalamus or pituitary infundibulum and cannot always be resected completely.15,18) Residual craniopharyngiomas sometimes require additional treatment, such as conventional irradiation, gamma knife radiosurgery (GKS),3,4,8) or stereotactic intracavitary implantation of radioisotopes.21) The endoscopic transventricular approach, which is a procedure similar to the third ventriculostomy, is safe and minimally invasive for the treatment of suprasellar cystic mass.5,6,11)

Here we describe our experience with the treatment of patients with suprasellar cystic craniopharyngiomas or Rathke cleft cysts using neuroendoscopic transventricular surgery with or without GKS.

Clinical Materials and Methods

I. Patient population

Five patients with symptomatic suprasellar cystic masses, four males and one female aged 46 to 76 years (mean 66.2 years), were treated by the neuroendoscopic transventricular approach. All patients showed signs and symptoms as follows: headache (four cases), visual disturbance (two cases), memory disturbance and disorientation associated with hydrocephalus (one cases). Preoperative pituitary function was mildly impaired in two patients (Table 1). Magnetic resonance (MR) imaging showed single cyst or multiple cysts with solid
Table 1  Clinical features and endoscopic procedures

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age</th>
<th>Sex</th>
<th>Clinical manifestations</th>
<th>Preoperative hypopituitarism</th>
<th>Preoperative MR imaging finding</th>
<th>Endoscopic procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76</td>
<td>M</td>
<td>dementia, incontinence, headache</td>
<td>no</td>
<td>single cyst with solid components, enhanced cyst wall and solid components</td>
<td>aspiration of cystic contents, resection of cyst wall and solid components</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>M</td>
<td>headache</td>
<td>present</td>
<td>single cyst with solid components, enhanced cyst wall and solid components</td>
<td>aspiration of cystic contents, resection of cyst wall and solid components</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>M</td>
<td>headache, hemianopsia</td>
<td>no</td>
<td>multiple cysts with solid components, enhanced cyst wall and solid components</td>
<td>first operation: aspiration of cystic contents, resection of cyst wall and solid components; second operation: aspiration of cystic contents, resection of cyst wall and solid components, replacement of the Ommaya reservoir</td>
</tr>
<tr>
<td>4</td>
<td>66</td>
<td>F</td>
<td>headache</td>
<td>no</td>
<td>single cyst without cyst wall enhancement</td>
<td>aspiration of cystic contents, resection of cyst wall</td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td>M</td>
<td>hemianopsia</td>
<td>present</td>
<td>single cyst without cyst wall enhancement</td>
<td>aspiration of cystic contents, resection of cyst wall</td>
</tr>
</tbody>
</table>

MR: magnetic resonance.

Fig. 1  Case 2.  A, B: Preoperative T1-weighted magnetic resonance (MR) images showing content of the suprasellar mass as a low intensity signal and the wall enhanced by gadolinium-diethylenetriaminepenta-acetic acid. The mass appears to elevate the floor of the third ventricle.  C, D: Postoperative MR images showing complete removal of the cyst content and decompression of the optic chiasma with residual cyst.  A, C: axial;  B, D: coronal images.

II. Neuroendoscopic procedures

Neuroendoscopic procedures were performed using an Olympus ventricular fiberscope (VEF-2; Olympus Optical Co., Tokyo) under general anesthesia. A right frontal burr hole was made along a straight line between the right foramen of Monro and the suprasellar mass. The dura was opened and a ventricular tap was made. The endoscope was directed along the same trajectory and advanced into the third ventricle. The tumor was inspected through the floor of the third ventricle. The cyst contents were first aspirated using an aspiration needle and then the following procedures were performed with continuous irrigation with acetated Ringer’s solution at 37°C to avoid chemical meningitis. A fenestration was made between the infundibular recess and the mammillary bodies in the midline by a Fogarty catheter (Figs. 3 and 4). The papillary solid parts and the cyst walls of craniopharyngioma were removed via biopsy forceps as far as possible and an Ommaya reservoir was placed, if necessary. The contents of Rathke’s cleft cyst were aspirated and the cyst walls were partially removed (Fig. 4).
Fig. 2 Case 5. A, B: Preoperative T1-weighted magnetic resonance (MR) images showing the content of the mass as a low intensity signal without enhancement by gadolinium-diethylenetriaminepenta-acetic acid. The floor of the third ventricle is elevated. C: Postoperative MR image showing complete removal of the cyst content. A: axial; B, C: coronal images.

Fig. 3 Case 2. Intraoperative neuroendoscopic images. A: The tumor is inspected through the floor of the third ventricle. The anterior floor of the third ventricle is slightly elevated. B: Needle puncture of the mass is performed and the motor oil-like contents were aspirated. C: The cyst wall was removed as far as possible using forceps. D: The solid components (arrow) are recognized on the inferior and left parts of the cyst wall.

Fig. 4 Case 5. Intraoperative neuroendoscopic images. A: Needle puncture of the cyst is performed via endoscopy through the third ventricular floor. B: Mucoid cloudy content ejects spontaneously after removal of the needle. C: The cyst wall was removed as far as possible using forceps. D: Diaphragma sellae (arrow) and cyst cavity of intrasellar portion are visible.

III. GKS
All patients with craniopharyngiomas underwent radiosurgery using a Leksell Gamma Knife unit model B (Elekta Instruments, Norcoss, Ga., U.S.A.). The GKS parameters and dose selection varied with the tumor size and spatial relationship to the visual pathway based on the Leksell GammaPlan Wizard 5.31 program (Elekta Instruments). The maximum
dose was 17 to 37 Gy, the margin dose was 11 to 18 Gy, and the dose to the optic pathways was 8 to 13 Gy.

### Results

A total of six endoscopic procedures were performed in the five patients (Table 1). The histological diagnoses were craniopharyngiomas in three cases and Rathke cleft cysts in two cases. The procedures were not very complicated in the four patients without ventricular dilation. However, MR imaging showed cystic enlargement 6 weeks after the endoscopic surgery in one patient (Case 3). He also complained of visual disturbance. Repeat endoscopic surgery was performed to decompress the cyst until the effects of GKS therapy manifested. The procedures were performed in a similar manner to the first operation using the previous skin incision and burr hole. The floor of the third ventricle, fenestrated during the previous operation, was covered and obliterated with the cyst wall of the tumor. Aspiration of the cyst content was performed again and an Ommaya reservoir was also inserted. The patient’s visual field and acuity improved and follow-up MR imaging showed marked reduction in the tumor size.

The neuroendoscopic procedures caused no mortality or major complication (Table 2). Only one patient (Case 3) suffered mild left hemiparesis after the second operation, considered to be due to a small infarction of the basal ganglia caused by systemic hypotension during the induction of general anesthesia. The patient was ambulatory and returned home 3 weeks after the second operation. The other four patients were able to return to their previous activities after experiencing substantial improvements in clinical symptoms. All patients received cortisone administration just before and after the operation, but this was needed only temporarily.

Three patients with craniopharyngiomas underwent GKS (Table 2). GKS could be safely performed because of the increased distance of the tumor from the optic chiasm and allowed for uncomplicated reduction of the cystic component.

The follow-up period after the endoscopic operation ranged from 5 to 13 months. One patient (Case 1) died 5 months after the operation without recurrence of the tumor on MR imaging. He died suddenly at his home and the cause of death was uncertain. Follow-up MR imaging showed complete removal of the cyst contents and clearly demonstrated the pituitary stalk and gland in the patients with Rathke cleft cysts, and tumor reduction and no recurrence in the patients with craniopharyngiomas.

### Discussion

Cystic mass lesions in the suprasellar cistern are often associated with neurological deficits, cognitive disorders, and endocrinological impairments, caused by attachments to critical structures such as the hypothalamus, optic nerves, pituitary stalk, and basal cerebrovasculature.

Many surgical approaches have been used to remove these mass lesions, including pterional, subtemporal, interhemispheric, transcortical, transcallosal, transsphenoidal, and translamina terminalis approaches. However, complete removal of the lesion is not technically easy without the risk of damaging the neurological and endocrinological functions due to the proximity to the surrounding structures. Recently, the surgical mortality and morbidity for these lesions have been considerably reduced. However, a neuroendoscopic approach might prove to be as effective as microsurgery but with less invasiveness in selected cases.

Usually only cases of hydrocephalus and benign cystic lesions in intraventricular and paraventricular locations are indicated for neuroendoscopic surgery. The endoscopic transventricular ap-

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**Table 2** Histology and postoperative clinical course

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Complication of endoscopic surgery</th>
<th>Histology</th>
<th>GKS marginal dose (Gy)</th>
<th>Follow-up period (months)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no</td>
<td>craniopharyngioma</td>
<td>17</td>
<td>5</td>
<td>died of unknown cause</td>
</tr>
<tr>
<td>2</td>
<td>no</td>
<td>craniopharyngioma</td>
<td>11</td>
<td>13</td>
<td>no tumor regrowth</td>
</tr>
<tr>
<td>3</td>
<td>mild left hemiparesis</td>
<td>craniopharyngioma</td>
<td>18</td>
<td>1.5</td>
<td>cyst regrowth</td>
</tr>
<tr>
<td>4</td>
<td>no</td>
<td>Rathke cleft cyst</td>
<td>—</td>
<td>13*</td>
<td>no tumor regrowth</td>
</tr>
<tr>
<td>5</td>
<td>no</td>
<td>Rathke cleft cyst</td>
<td>—</td>
<td>6</td>
<td>no cyst regrowth</td>
</tr>
</tbody>
</table>

*From 2nd operation. GKS: gamma knife radiosurgery.
proach, which is a procedure similar to third ventriculostomy, has been commonly used and requires minimal invasiveness for removing benign suprasellar cystic lesions, especially arachnoid cysts.\(^3\) In particular, suprasellar cystic lesions growing posteriorly or elevating the floor of the third ventricle have become indicated for this procedure because the inferior wall of the third ventricle can be adequately inspected through the neuroendoscope.

Benign cystic mass lesions such as Rathke cleft cysts only require draining of the cyst contents, not removal of the cyst wall. Therefore, we recommend neuroendoscopic surgery as the therapy of first choice for benign cystic mass lesions. Our experience with Rathke cleft cysts without hydrocephalus showed that a steerable endoscope with an outer diameter of 4.2 mm could be easily passed through the foramen of Monro. Partial resection of the cyst walls was not accompanied by massive bleeding, because the cysts did not adhere tightly to the surrounding structures. The clinical outcomes of patients with Rathke cleft cysts were excellent.

In contrast, the management of craniopharyngiomas remains controversial.\(^1\) Many previous studies concluded that gross total resection of the tumor is enough to prevent recurrence of the cyst.\(^2\) Recently, the treatment options for cystic craniopharyngiomas in the suprasellar cistern that show neoplastic growth are surgical resection by various approaches, and stereotactic intracavitary implantation of radioisotopes, GKS, and combined therapy.\(^2\)

GKS treatment may be effective in achieving long-term control of tumors without compromising the quality of patient survival.\(^4,8\) Long-term results of combined treatment with surgery and radiation demonstrate that survival rates for patients treated with subtotal removal and irradiation are better than for those with only subtotal removal.\(^3,20\) Radiation tolerance of the optic apparatus presents a problem with GKS treatment in patients with craniopharyngioma. However, patients who received a local dose of up to 12 Gy to the anterior optic pathway (nerve or chiasm) had a low risk of developing clinically symptomatic radiation optic neuropathy.\(^12,19\)

Treatment selection for individual patients is difficult. We consider that children and adult patients with craniopharyngioma and a long life expectancy should be treated by surgery with the primary goal of achieving complete microscopic removal only in selected cases, particularly if the tumor is small. Radiotherapy is a valuable treatment option and is likely to result in less morbidity and equivalent, if not better, tumor control. However, we should consider the adverse effects associated with cerebral irradiation, especially in children and adult patients with a long life expectancy. The risk of tumor induction by irradiation can be significant in a young child with a benign lesion. Therefore, total removal is the first choice of treatment for a child with craniopharyngioma. If total removal fails, then more conservative approaches utilizing radiotherapy can be used. In addition to the patient's age and past history, the tumor characteristics are important, such as computed tomography/MR imaging appearance, location, size, cystic or solid, presence of calcification, and relationship with the surrounding tissue.

Neuroendoscopic surgery combined with GKS has produced encouraging results without increasing mortality and morbidity, and can be effective in achieving the long-term control of tumors without compromising the quality of patient survival.\(^5,10,20\)

Our experience suggests that neuroendoscopic surgery combined with adjuvant GKS is effective for the treatment of cystic craniopharyngiomas. The presence of a single cystic lesion is the best indication for endoscopic surgery but a multicystic lesion can also be treated by opening all of the cysts. In addition, continuous irrigation with acetylated Ringer's solution should avoid chemical meningitis in cases of craniopharyngioma.

Enlargement of the cyst shortly after the first operation in one of our cases suggests that the opening of the cyst by a Fogarty catheter is not sufficient to avoid enlargement of the cyst. More extensive resection of the cyst walls with biopsy forceps or introducing an Ommaya reservoir during the first operation to decompress the cyst are required until the effect of GKS is manifested.

Neuroendoscopic surgery obtained encouraging results in our patients with suprasellar cystic masses. This approach offers minimally invasive treatment of patients with suprasellar cystic lesions and allows evaluation of the anatomy surrounding these lesions.\(^1\) Our experience indicates that endoscopic procedures are a promising alternative to microsurgical operations for the treatment of suprasellar cystic mass lesions.

**References**

Neuroendoscopic Transventricular Surgery for Suprasellar Cysts

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Commentary on this paper appears on the next page.
Commentary

This interesting report of five cases, three craniopharyngiomas and two Rathke’s cleft cysts, illustrates very clearly the still existing controversy of adequate treatment of craniopharyngiomas. Elegant neuroendoscopic transventricular surgery has been performed, passing the foramen of Monro and opening the floor of the third ventricle. While drainage of a Rathke’s cleft cyst is sufficient and recurrence only rarely occurs, a pure symptomatic treatment of evacuating the cyst in a craniopharyngioma works on a long-term basis (similar to stereotactic cysto-ventriculostomy) only in pure cystic tumors. The controversy of complete tumor removal versus minimal invasive symptomatic treatment still exists, especially for partially solid craniopharyngioma. As an argument against radical removal, the authors emphasize restriction of completeness and higher morbidity. The three reported cases with craniopharyngiomas had two “events”: one patient died after five months with unknown origin (could it be hyponatremia or hyperosmolarity as a typical delayed complication in craniopharyngiomas?), a second one with a recurrent tumor suffered mild basal ganglia infarction. In these three cases, the endoscopic procedure was followed by radiosurgery with the gamma knife. Follow-up time is too short to report on results, but we know from conventional radiotherapy that an increasing pituitary insufficiency will occur in 3 to 5 years.

From my experience, complete removal in experienced hands, if indicated, predicts the best long-time outcome,1) which the authors agree with, especially for childhood. In our series with giant craniopharyngiomas, performing the bifrontal-subfrontal lamina terminalis approach, we were able to resect giant craniopharyngiomas totally in more than 80–90% (n = 24 from 27 patients) without mortality and low morbidity in the last 8 years. However, as a consequence of partial resection of the pituitary stalk, a high risk of additional pituitary insufficiency (about 30%) exists, especially for diabetes insipidus (unpublished data).

I suggest that Rathke’s cleft cyst, which can, in the majority of cases, be removed or evacuated by the transsphenoidal approach, will not remain the major domain of neuroendoscopy. In these cases, intraoperative and pathological diagnosis will still be difficult, especially the differential diagnosis of craniopharyngiomas. This excellently written paper makes again clear that the controversy is not over and that the individual decision for the variety of surgical and even non-surgical procedures and maneuvers is a challenge and burden, even in the hands of experienced pituitary neurosurgeons.

Reference


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The authors demonstrate their experience in treating three cystic craniopharyngiomas (CRPs) and two Rathke’s cleft cysts (RCCs) by endoscopic partial removal followed by gamma knife radiosurgery for CRPs. The point that the authors want to emphasize is a lower complication rate compared with microsurgery in patients with a suprasellar cystic lesion. This method should be very safe and attractive during the early postoperative period. However, not all patients with a cystic CRP are to be treated with this treatment modality at the initial surgery, because partially removed CRPs frequently recur even after the subsequent irradiation. Especially, a cystic CRP tends to show cystic recurrence, like Case 3 in this report. The maximum follow-up period in this report is only 13 months. This is why the remaining two cases do not yet develop recurrence.

It is suggested that the endoscopic partial removal followed by gamma knife radiosurgery for treating CRPs may play a palliative role in a subset of patients with a poor medical condition or old age, and may also be used as an alternative in treating a recurrent cystic CRP when an additional microsurgical procedure is likely to bring a high risk of neurological and endocrinological dysfunction without any guarantee of cure.

The authors’ endoscopic approach can be useful for treating a RCC, because many RCCs do not recur even after simple cyst aspiration and fenestration. However, it is to be noted that there are a wide range of spectrum in RCC, from “classic” epithelial cyst to “CRP-like” cyst wall which often recur or regrow after partial removal.1,2) This “CRP-like” RCC which often shows enhancing solid portions within the cyst on MR images frequently demonstrates a squamous metaplasia of the cyst epithelium, and rarely a concurrent portion typical of a CRP histologically. Therefore, during surgery of a RCC, very careful inspection of the cyst wall under the endoscopic view is necessary. When a thickened wall or a solid nodule exists, careful resection and biopsy of that portion should be performed.

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References


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