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ORIGINAL ARTICLE

The role of the endoscope in the transsphenoidal management of cystic lesions of the sellar region

Luigi M. Cavallo · Daniel Prevedello · Felice Esposito · Edward R. Laws Jr. · Joshua R. Dusick · Andrea Messina · John A. Jane Jr. · Daniel F. Kelly · Paolo Cappabianca

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Abstract Cystic mass lesions within the sella turcica are common, and they include cystic pituitary adenomas, craniopharyngiomas, Rathke's cleft cysts, arachnoid cysts, and other entities. Until recently, such lesions were typically removed by a microsurgical transsphenoidal route. Given the increased use of the endoscope in transsphenoidal surgery, we evaluated the potential benefits of this tool in the treatment of such lesions. Between January 1997 and March 2005, 76 consecutive patients with sellar–suprasellar cystic lesions treated in three Neurosurgical Divisions underwent transsphenoidal removal in which the endoscope was used at least during the sellar step of the procedure (endoscope-assisted or fully endoscopic). The series consisted of 26 pituitary macroadenomas, 20 Rathke's cleft cysts, 18 craniopharyngiomas, 10 arachnoid cysts, one craniopharyngioma associated with an adrenocorticotropic hormone-secreting adenoma, and one chordoid glioma. Rigid 4-mm endoscopes (0°, 30°, and/or 45°) were used, and the advantages and limits of the endoscope during the sellar step of the procedure were recorded. Endoscopic exploration after lesion evacuation was generally easier and of greatest efficacy when the residual cystic cavity was larger as opposed to smaller. The use of angled endoscopes was optimal in larger residual cavities. Early descent of the suprasellar cistern, bleeding inside the residual cyst cavity, and a small sella were the most common causes preventing thorough exploration of the residual cavity after its evacuation. In no cases did the endoscope cause injury during the sellar cavity exploration. Endoscopic exploration of the sellar cavity during transsphenoidal surgery offers both general and specific advantages in the treatment of a variety of different cystic sellar lesions. Its routine use during transsphenoidal surgery for such lesions is recommended to achieve maximal and safe tumor removal.

Keywords Endoscope · Arachnoid cyst · Craniopharyngioma · Pituitary adenoma · Rathke's cleft cyst · Sellar cyst · Transsphenoidal · Endonasal surgery

L. M. Cavallo (✉) · F. Esposito · A. Messina · P. Cappabianca
Department of Neurological Sciences, Division of Neurosurgery,
Università degli Studi di Napoli Federico II,
Via Sergio Pansini, 5,
80131 Naples, Italy
e-mail: lcavallo@unina.it

D. Prevedello · E. R. Laws Jr. · J. A. Jane Jr.
Department of Neurosurgery, University of Virginia,
Charlottesville, VA, USA

J. R. Dusick · D. F. Kelly
Department of Neurosurgery,
University of California at Los Angeles,
Los Angeles, CA, USA

Introduction

The sellar region can be affected by a variety of cystic lesions, including cystic adenomas, craniopharyngiomas, Rathke's cleft cysts, and arachnoid cysts. The distinction among these lesions can sometimes be difficult because their symptoms, signs, and imaging characteristics can mimic each other. Although the presurgical management of these patients is similar (clinical history, neurological examination, sellar imaging, endocrinological and ophthalmological evaluation), their surgical management and outcomes are quite different [2, 11, 23].

The transsphenoidal microsurgical approach is currently considered the procedure of choice in the majority of patients with cystic sellar lesions, even when there is

suprasellar extension [2, 11, 23, 24, 26]. The recent use of the endoscopic endonasal approach to the sellar region which brings the eyes of the surgeon inside the sellar cavity has offered the possibility of obtaining a wider and closer view of the surgical target [3, 6, 12] when compared to the microscopic.

Three series of patients were collected in three separate institutions (Division of Neurosurgery, Università degli Studi di Napoli Federico II, Naples, Italy; Department of Neurosurgery, University of Virginia, Charlottesville, VA, USA; Department of Neurosurgery, University of California at Los Angeles, USA). The patients were operated upon by an endoscopic endonasal transsphenoidal approach [3, 4, 6, 12] in the first two institutions or with the endoscope-assisted endonasal transsphenoidal approach in the third [31].

From these series, we analyzed 76 cases of cystic sellar lesions to evaluate the benefits added by the endoscope in their management. Some case examples are presented to illustrate technical points in approaching these different lesions.

Materials and methods

Between January 1997 and March 2005, 76 patients underwent endoscopic endonasal transsphenoidal surgery for cystic sellar lesions. The series consisted of 26 pituitary macroadenomas [25 nonfunctioning and one growth-hormone (GH)-secreting adenomas], 20 Rathke's cleft cysts, 18 craniopharyngiomas, 10 arachnoid cysts, one craniopharyngioma associated with an adrenocorticotropic hormone (ACTH)-secreting adenoma, and one chordoid glioma.

Full endocrinological evaluations of pituitary function were performed preoperatively, 3 and 6 months after surgery, and yearly thereafter in all patients. Neuroradiological studies included sellar magnetic resonance imaging (MRI) before and after intravenous paramagnetic (Gd-DTPA) contrast. A postoperative neuroradiological evaluation by means of an MRI was scheduled 3 months after surgery and typically at least annually thereafter. All patients with clinical and/or radiological evidence of chiasmal compression underwent formal visual field examination and examination of visual acuity.

In all cases, during the sellar step of the procedure, a rigid endoscope (0°, 30°, and/or 45°; 18–30 cm in length) was passed into the tumor cavity to evaluate the presence of residual tumor and the adequacy of decompression.

Operative notes and intraoperative videos were reviewed to confirm the endoscopic findings. Postoperative notes, clinic notes, MRI reports, and hormonal studies were reviewed to document postoperative visual outcomes, hormonal status, and surgical complications.

Results

Patient cohort—preoperative status The 76 patients included 46 women and 30 men, mean age 44.7 years. Preoperative clinical findings are presented in Table 1.

Twenty-five patients (34.2% of cohort) had a cystic nonfunctioning macroadenoma, including 13 men and 12 women (mean age 43.8 years, range 16–80 years), and one woman had a GH-secreting cystic adenoma. Ten patients presented with visual field defects; six female patients had oligomenorrhea, five male patients had impotence, one patient had diabetes insipidus. Headache occurred in six patients; seven patients had panhypopituitarism; in two cases, the adenoma was an incidental finding, and two patients had undergone previous microsurgical transsphenoidal surgery.

Twenty patients (26.3% of cohort) had a Rathke's cleft cyst (including 18 women and 2 men; mean age 44.7 years, range 21–69 years). The majority of these patients

Table 1 Preoperative clinical findings

Symptom	Craniopharyngiomas	Rathke's cleft cysts	Arachnoid cysts	Cystic pituitary adenomas	Craniopharyngioma ACTH adenoma	Chordoid glioma
	No. (%)					
Headache	2/18 (11)	9/20 (45)	2/10 (20)	6/26 (23)	–	–
Visual field defect	13/18 (72)	7/20 (35)	7/10 (70)	10/26 (38)	1/1 (100)	1/1 (100)
Menstrual irregularities	3/18 (16)	5/20 (25)	–	6/26 (23)	–	–
Impotence	3/18 (16)	1/20 (5)	3/10 (30)	5/26 (19)	–	–
Hypopituitarism	11/18 (61)	7/20 (35)	–	7/26 (26)	1/1 (100)	1/1 (100)
Hyperprolactinemia	2/18 (11)	4/20 (20)	2/10 (20)	3/26 (11)	–	–
Diabetes insipidus	5/18 (28)	–	–	1/26 (4)	1/1 (100)	1/1 (100)
Incidentally discovered	–	3/20 (15)	–	2/26 (8)	–	–

Table 2 Postoperative improvement of clinical dysfunction

Symptoms	Craniopharyngiomas	Rathke's cleft cysts	Arachnoid cysts	Cystic pituitary adenomas	Craniopharyngioma ACTH adenoma	Chordoid glioma
	No. (%)					
Headache	1/2 (50)	7/9 (78)	1/2 (50)	6/6 (100)	–	–
Visual field defect	12/13 (92)	7/7 (100)	7/7 (100)	10/10 (100)	0/1 (0)	0/1 (0)
Menstrual irregularities	0/3 (0)	2/5 (40)	–	4/6 (66)	–	–
Impotence	2/3 (66)	0/1 (0)	0/3 (0)	1/5 (20)	–	–
Hypopituitarism	0/11 (0)	4/7 (57)	–	1/7 (14)	0/1 (0)	0/1 (0)
Hyperprolactinemia	2/2 (100)	1/4 (25)	2/2 (100)	3/3 (100)	–	–
Diabetes insipidus	0/5 (0)	–	–	0/1 (0)	0/1 (0)	0/1 (0)

presented with headache and visual field deficit due to chiasmal compression. Five female patients had amenorrhea or oligomenorrhea, and one man had impotence; seven patients had panhypopituitarism. In three cases, the lesion was discovered incidentally. Two patients underwent a previous microscopic transsphenoidal procedure.

Eighteen patients (23.6% of cohort) had a craniopharyngioma (including ten men and eight women; mean age 43.6 years, range 8–79 years). Five patients were operated on for tumor recurrence previously treated by a transcranial approach in four cases and by a sublabial transsphenoidal approach in one case; 11 patients presented with various degrees of pituitary deficiency; 5 had diabetes insipidus; 2 had headache; 3 patients presented decrease in libido and impotence, 3 women with menstrual irregularities, 2 with hyperprolactinemia; 13 had varying degrees of visual field defects.

Ten patients (six women and four men; mean age 48.6 years, range 17–68 years) had arachnoid cysts (13.1%). Seven presented with visual field deficits. One man and one woman had hyperprolactinemia; three men presented with impotence.

One patient had a craniopharyngioma associated with an ACTH-secreting adenoma and had a previous microscopic transsphenoidal operation, and another patient proved to have a chordoid glioma. Both patients had visual deficits, hypopituitarism, and diabetes insipidus.

Endoscopic findings As a general consideration, valid for the different cystic lesions, the endoscope proved to be more useful in cases with a large residual cavity at the completion of cyst evacuation. When the suprasellar cistern immediately prolapsed into the residual cavity, endoscopic exploration was more difficult. In fact, in such cases, the cistern had to be elevated to explore the walls of the sellar cavity; however, this maneuver was not always possible. Another factor for intrasellar endoscopic exploration was the size of the sellar cavity. When the sella was large, which is quite frequent in case of intrasellar or intrasuprasellar arachnoid cyst, endoscopic exploration of the residual cavity allowed for better appreciation of the differences of the visualization provided by the 0° and angled optics (30° and 45°). In fact, while the intrasellar exploration with the 0° scope optimally visualized the dorsum sellae, the posterior aspect of the suprasellar cistern, and of the lateral walls of the sella, the angled scopes allowed a wider and more panoramic visualization of the suprasellar cistern and the entire sellar cavity. On the other hand, in a normal or small sellar cavity, common in case of craniopharyngioma

Table 3 Surgical complications

Lesion	No. of cases	Type of complication	Management
Craniopharyngiomas	3	Visual worsening (right superior temporal field cut)	Steroids/observation
		DI	DDAVP
		DI	DDAVP
Rathke's cleft cysts	4	Thalamic ischemia	
		CSF fistula	Reoperation
		DI	DDAVP
		DI	DDAVP
Arachnoid cysts	2	CSF fistula	Reoperation+lumbar drainage
		CSF fistula and meningitis	Reoperation+medical treatment
Cystic pituitary adenomas	3	Hypopituitarism	Hormonal replacement
		CSF fistula and meningitis	Reoperation+medical treatment
		DI	DDAVP

Table 4 Conditioning factors of the endoscope sellar exploration

Conditioning factors
Size of the sella
Descent of the suprasellar cistern
Sellar and/or epidural venous bleedings

or Rathke's cleft cyst, the exploration of the residual cavity was only possible with the 0° optic, and the use of angled scopes (30° and 45°) was less helpful or was quite difficult to perform.

Postoperative clinical changes and surgical complications of the present series are reported in Tables 2 and 3. The presence of venous bleeding inside the sellar cavity or epidural oozing after evacuation of the cystic lesion was another factor making intrasellar endoscopic exploration more difficult (see Table 4).

Because the surgical management and outcome of the different lesions is variable, the advantages and limits of the endoscope during the sellar step of the procedure have been considered separately. Illustrative cases are presented to better discuss such differences.

Cystic pituitary adenomas

Total tumor removal, confirmed by postoperative MRIs, was obtained in 23 of 26 (88%) cases. Visual field impairments and headache resolved in all cases. Preoperative hypopituitarism, except in one case, was unaffected by surgery; one woman developed hypopituitarism requiring hormonal replacement therapy. Complications included one cerebrospinal fluid (CSF) fistula and meningitis and one case of new onset of permanent diabetes insipidus. The postoperative stay ranged from 1 to 8 days (mean 3.7 days); follow-up ranged from 5 to 108 months (mean 55.7).

Illustrative case A 48-year-old woman presented blurred vision, bitemporal hemianopia, and mild hyperprolactinemia due to an intrasuprasellar cystic pituitary adenoma (see Fig. 1). After the dural opening, hemorrhagic fluid was evacuated, and an initial descent of the suprasellar cistern was observed. Entering the sellar cavity with the 0° endoscope, the tumor capsule was exposed and dissected from the suprasellar cistern and was partially removed (see Fig. 2), to avoid postoperative worsening of pituitary function. The postoperative course was uneventful. Her bitemporal hemianopia rapidly improved, and she was discharged on postop day 2. Histological studies confirmed the diagnosis of a "null-cell" adenoma. A postoperative MRI confirmed the gross total removal of the cystic adenoma, and the visual fields showed improvement. Follow-up MRI scans, 3 years later, did not show evidence of recurrence (see Fig. 3).

Arachnoid cysts

All ten arachnoid cysts were emptied, and in all cases, patients underwent sellar packing, with either a fat graft and/or collagen sponge, and sellar floor reconstruction. Operative morbidity in this group included one case of postoperative CSF fistula and one case of postoperative CSF fistula and meningitis. Both of these cases were treated with reoperation and lumbar drainage for 48 h. Visual field deficits improved in all cases. The postoperative stay ranged from 3 to 6 days (mean 4.2 days). The follow-up

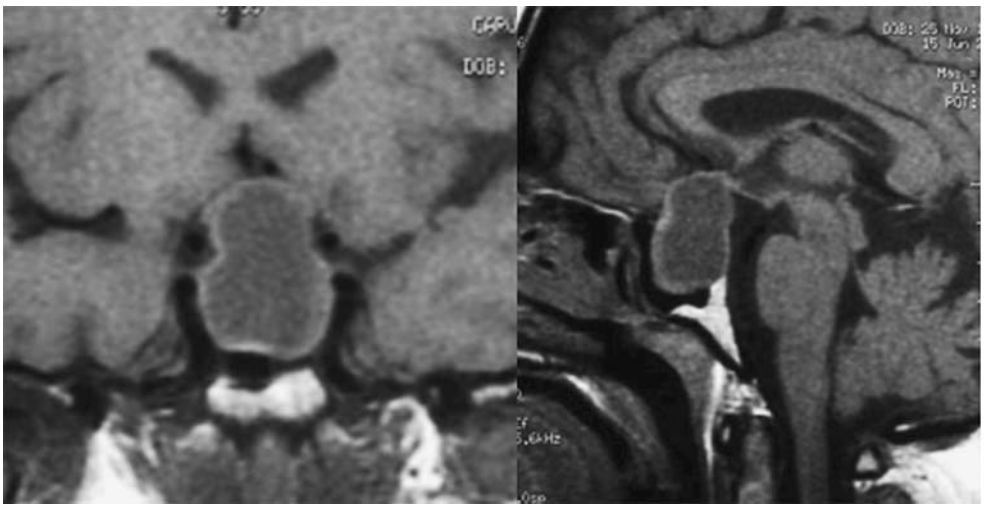

Fig. 1 Preoperative postcontrast pituitary MRI showing an intrasuprasellar cystic pituitary macroadenoma

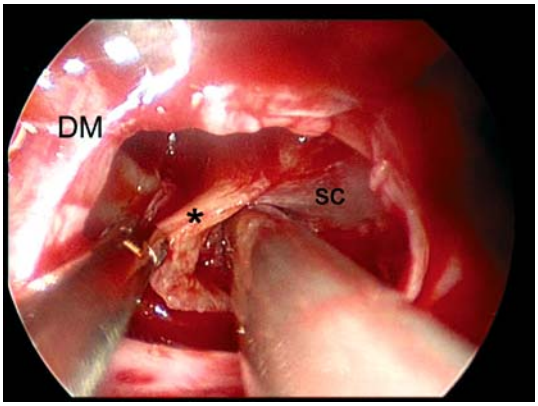

Fig. 2 Intraoperative photo showing dissection of the tumor capsule from the suprasellar cistern (*SC*). Tissue (*asterisk*) on the posterior part of the suprasellar cistern and dorsum sellae has not been removed because it usually contains thinned normal pituitary gland

ranged from 10 to 94 months (mean 36.9). One patient had cyst recurrence after 16 months, treated with repeat endoscopic endonasal surgery.

Illustrative case A 20-year-old woman had a history of recurrent headache. Neuroradiological evaluation showed a large intrasuprasellar arachnoid cyst with chiasmal compression (see Fig. 4). Visual field examination showed superior bitemporal hemianopia, and pituitary function was normal. The patient underwent an endoscopic endonasal transsphenoidal approach. After sellar floor and dural opening, the cyst was evacuated. With the 0° endoscope in a close-up view inside the sellar cavity, it was possible to visualize the dorsum sellae and the posterior portion of the suprasellar cistern. The angled endoscope (30°) was then introduced inside the sella. It allowed a wider visualization of the suprasellar cistern. Thanks to the angled endoscope, two defects were identified in the arachnoid of the suprasellar cistern. These confirmed that the cystic space was communicating with the subarachnoid space (see Fig. 5). An accurate sellar floor reconstruction was made with collagen sponge and synthetic rigid dural substitute. The postoperative course was uneventful, and the patient was discharged on postop day 3. Two months after surgery, the patient presented with a CSF leak complicated by *Haemophilus influenzae* meningitis, which was successfully treated with intravenous antibiotics without any neurological deficit. The CSF leak required reoperation for sellar reconstruction with bone and mucoperichondrium harvested from the right middle turbinate. No lumbar drainage was used. Two years after the first operation, the MRI showed obliteration of the arachnoid cyst, and the neurological exam confirmed resolution of the preoperative visual field defect (see Fig. 6).

Rathke's cleft cysts

Cyst emptying confirmed by MRI was achieved in 18 of 20 (90%) patients. In the surgical management of Rathke's cleft cyst at all three participating centers, we have used the following policy: In case of intrasellar or intrasuprasellar lesion, we emptied the cyst and performed only a partial removal of the capsule, to avoid postoperative worsening of the pituitary function. In the case of purely suprasellar lesions, the thin tumor capsule was usually completely removed. In seven patients, the sellar floor was reconstructed because of an intraoperative CSF leak, while in other cases, the sellar floor was intentionally left open. Complications included one patient with a small left thalamic infarct, two cases of permanent DI, and one patient with a postoperative CSF leak that required an endoscopic reoperation. The postoperative stay ranged from 3 to 8 days (mean 3.7 days); follow-up ranged from 7 to

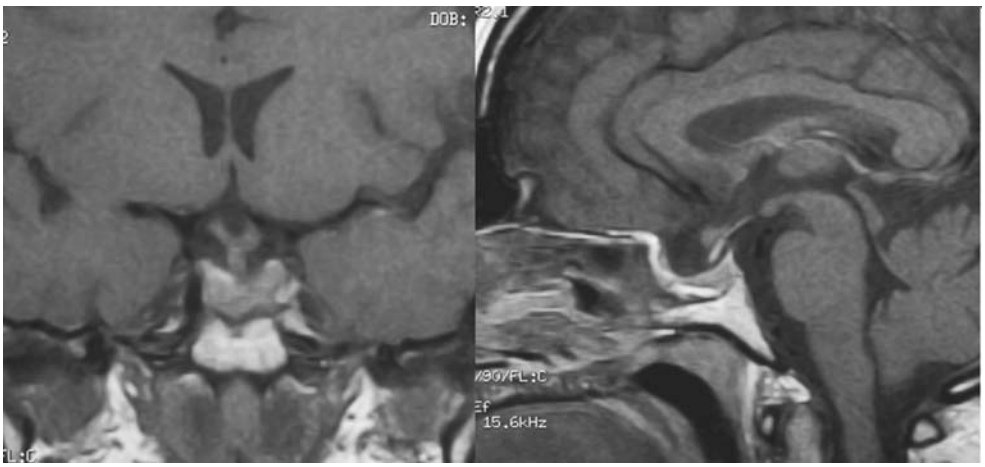

Fig. 3 Postoperative postcontrast pituitary MRI showing removal of the lesion with preservation of the normal pituitary gland

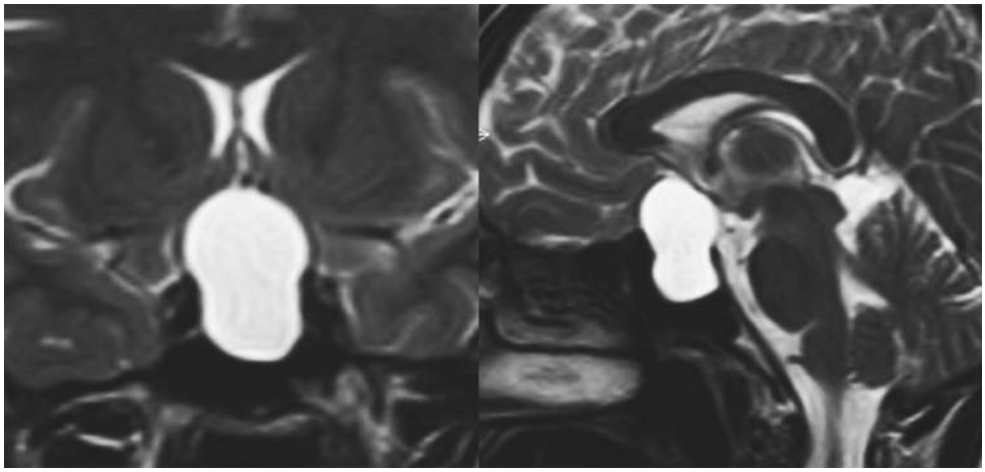

Fig. 4 Preoperative postcontrast pituitary MRI showing an intrasuprasellar arachnoid cyst

70 months (mean 43 months). Two patients developed a recurrent cyst which required reoperation.

Cystic craniopharyngiomas

Thirteen of 18 (72%) craniopharyngiomas were grossly totally removed. Ten patients had an intraoperative CSF leak that required sellar reconstruction; in the other cases, the sellar cavity was packed with gelfoam or left communicating with the sphenoid sinus. Visual field deficits improved in 12 of 13 Patients (92%). Preoperative hypopituitarism did not improve in any patient. Complications included one case of pneumocephalus requiring reoperation the same day and one case of visual worsening

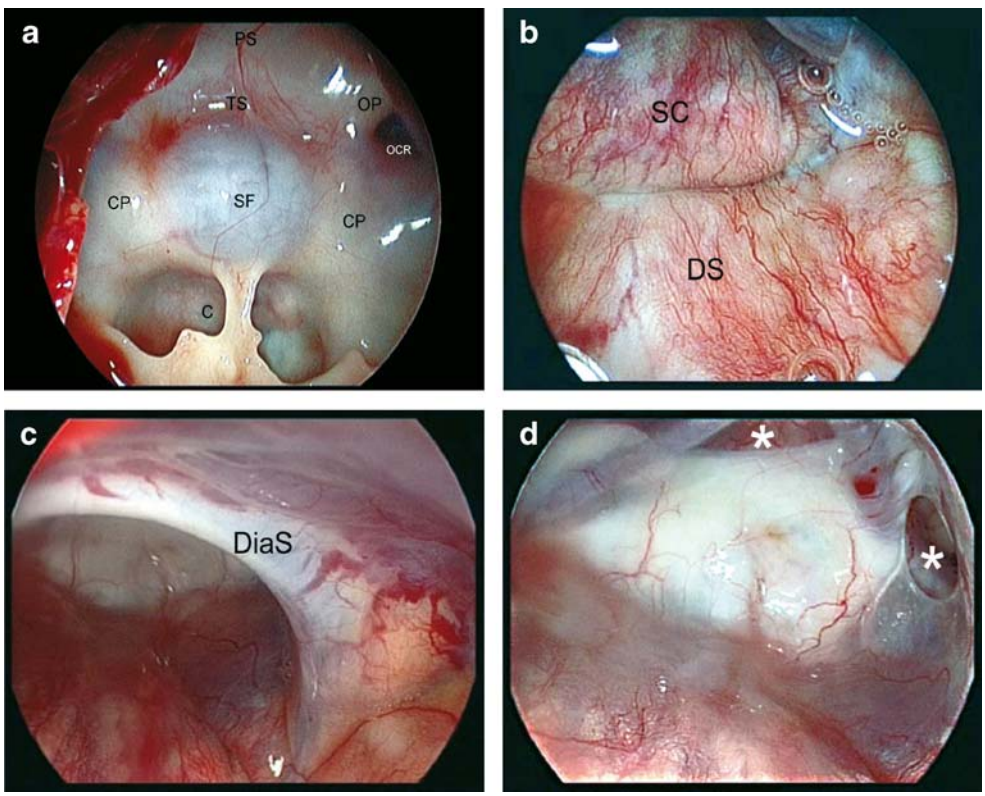

Fig. 5 **a** Intraoperative photo showing a panoramic view inside the sphenoid sinus. Note the thinned sellar floor (*SF*), carotid protuberance (*CP*), optic protuberance (*OP*), and opto-carotid recess (*OCR*). **b** Intrasellar exploration with a 0° endoscope showing the dorsum sellae (*DS*) and only a limited part of the suprasellar cistern (*SC*). **c** Intrasellar exploration with the 30° angled endoscope permitted visualization of the anterior diaphragma sellae (*DiaS*), while a further introduction of the same endoscope in the sella (**d**) permitted to identify two defects in the suprasellar cistern (*asterisk*)

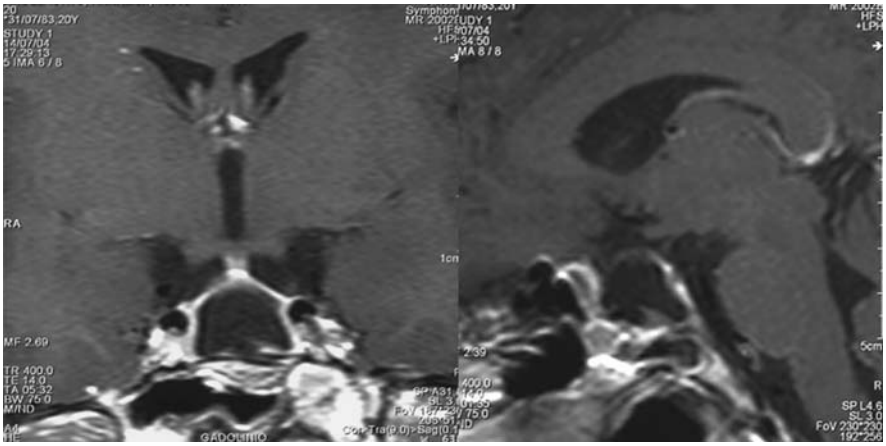

Fig. 6 Postoperative postcontrast pituitary MRI showing the volumetric reduction of the cyst. The intrasellar part of the cyst covered by normal pituitary tissue is evident, and there is no chiasmal compression

(right superior temporal field cut). Two patients developed permanent diabetes insipidus. The hospital stay ranged from 3 to 25 days (mean 5.7 days); follow-up ranged from 3 to 96 months (mean 38.5 months). Three patients had a second transsphenoidal operation, and two underwent postoperative radiotherapy. One patient had a recurrence treated with radiosurgery 4 years after surgery, and another was given radiotherapy for residual tumor.

Other lesions

The craniopharyngioma associated with an ACTH-secreting adenoma was totally removed. In this case, a second operation was needed for CSF fistula repair. The chordoid glioma was radically removed. The preoperative findings were resolved in both cases.

Discussion

Sellar and suprasellar cystic pituitary adenomas and craniopharyngiomas are the most common cystic lesions in the sellar area. Less frequent are symptomatic Rathke's cleft cysts, arachnoid cysts, and epidermoid cysts. Although they seem to be relatively easy to manage when compared with other solid lesions, they may present several problems demanding special consideration [2, 11, 23, 24].

Previous experience with the microsurgical transsphenoidal approach has given us the opportunity to evaluate the actual benefits provided by the endoscope.

The endoscopic endonasal approach to the sellar region is an accepted alternative technique for the treatment of the sellar lesions [3, 4, 6]. The properties of the endoscope such as wider surgical field, close-up and multiangled vision, and minimal invasiveness offer particular advantages in the surgical management of cystic sellar lesions [1, 10, 18].

These benefits primarily concern the use of the endoscope during the sellar phase of the procedure, and therefore, they can be considered valid also for microsurgical endoscope-assisted procedures.

Because the endoscope visualizes the surgical field from within, differently from the microscope, the first requisite is the presence of a cavity inside which it can be successfully employed. The larger such a cavity is, the more useful is the information obtained with endoscopic exploration. This means that, even after the cyst evacuation, if the residual cavity is occupied by either the suprasellar cistern or blood, or when the sellar cavity is too small, the endocavitary endoscopic exploration may be quite difficult or even impossible.

The most important information obtained during endoscopic exploration is provided by the 0° endoscope. Angled endoscopes can give further information only when the residual cavity is large enough, the suprasellar cistern has not obliterated the tumor cavity, and when there is no significant bleeding within the sella. Such conditions are more frequent in case of arachnoid cysts and cystic craniopharyngiomas.

We observed that there are several differences in the technique of removal of a cystic pituitary tumor with respect to noncystic pituitary lesions. In fact, in noncystic pituitary lesions, the removal of the lesion is sequential following a well-established sequence, valid either for endoscopic or microsurgical technique. In cystic pituitary adenomas, after the evacuation of the cystic content of the lesion, there is usually a prompt descent of the suprasellar cistern that occupies the whole sellar cavity, making its inspection difficult. Elevation of the suprasellar cistern allows the endoscopic exploration throughout the sellar cavity, facilitating the identification and removal of remnants of adenomatous tissue between the cistern and the walls of the sellar cavity and nondescended remnants in the superior aspects of the suprasellar tumor extension. To

obviate the descent of the suprasellar cistern, it has been proposed the use of the spinal drainage, put at the beginning of the operation, for aspiration of the CSF to raise the folded cistern and permit a better endoscopic intracavitary inspection for possible tumor remnants.

In cystic pituitary adenomas, the tumor capsule often contains the normal pituitary gland, which should be preserved. The endoscope is useful for identifying the interface between the tumor capsule and the suprasellar arachnoid cistern and for dissecting the capsule away from the cistern. As for the Rathke's cysts, it is our policy to leave part of this capsule intact, if it is adherent to the surrounding tissues, to avoid possible postoperative worsening of pituitary function.

Although many authors have reported good results with transcranial treatment of sellar cysts [19, 29, 30], we believe that this procedure is justified only for lesions with a large and predominant suprasellar development. Several authors reported their experience in the treatment of cystic sellar lesions by the microsurgical transsphenoidal approach [5, 8, 9, 14, 15, 20, 22]. This technique permits incision and the drainage of the cyst and, if necessary, the removal of a portion or even the entire capsule.

One of the most important problems in the transsphenoidal management of intrasuprasellar arachnoid cysts is to determine whether they communicate with the subarachnoid space. One empiric method is to scrutinize the refilling of the sellar cavity after it has been emptied, confirming the communication of the cyst with the subarachnoid space. Nevertheless, this does not occur in all cases: Sometimes, the communication is very small, and even after the marsupialization of the cyst, a CSF leak may not be visible. In our experience, endoscopic exploration of the sellar cavity may facilitate the identification of an eventual communication of the cyst with the subarachnoid space. Angled endoscopes (30° and 45°) permit a panoramic exploration of the entire cyst wall allowing in many instances, localization of the communication, if any. In our experience, small intrasellar cysts are usually noncommunicating, while a communication with the subarachnoid space, even if very small, is usually present in the larger intrasuprasellar arachnoid cysts. An indirect sign of communication between the arachnoid cyst and the subarachnoid space may be the intraoperative presence of small air bubbles behind the cyst wall.

For the management of cystic craniopharyngiomas, the endoscope, during and after the evacuation of the cyst contents, allows the surgeon to explore the inner aspect of the cyst wall, to verify the completeness of cyst content removal and to assess the possible presence of CSF leakage. In selected cases when no CSF leakage occurs and the surgeon does not feel comfortable resecting the capsule, usually due to its possible adherence to neurovascular structures, cyst recurrence may be prevented with the insertion inside the cystic cavity, after its evacuation, of an inert catheter provided with multiple holes and communicating with the sphenoid cavity [25]. Although this procedure has been described with the microsurgical transsphenoidal approach [7, 26], we believe that the endoscope can represent a useful adjunctive tool when the cystic component of the craniopharyngioma is out of the direct view of the microscope, as in the case we reported. Retrosellar and suprasellar areas are more easily visualized with the endoscope, especially with angled scopes (mainly 30°) and in case of prefixed chiasm; therefore, its use can simplify the correct positioning of the catheter in the cyst. This technique can be used unless there is evidence of intraoperative CSF leak as a consequence of a rent in the arachnoid membrane. In such cases, the leakage needs to be treated with sellar reconstruction to avoid possible major complications, such as meningitis and tension pneumocephalus.

Previous studies have shown that radical resection of craniopharyngiomas is correlated with lower rates of recurrence [15–17, 21, 28]. A patient presenting with panhypopituitarism is an example of a situation where the surgeon can feel secure aiming for a radical resection of a cystic craniopharyngioma [21]. The surgeon must also be aware of the possibility of adhesions, particularly in recurrent cases [15–17]. The ability to deflate the cyst and at the same time mobilize its capsule are important factors in acquiring a satisfactory removal of the lesion and consequently in preventing recurrence [13, 28]. The endoscope has been shown to be an important tool assisting the visualization and allowing dissection of the tumor capsule away from the deep structures of the suprasellar and basal cisterns [27].

Concerning the surgical management of Rathke's cleft cysts, we distinguish the purely suprasellar cysts from the intrasellar and intrasuprasellar ones. In case of mainly suprasellar cysts, with the normal pituitary gland easily identifiable, we try to obtain complete removal of the tumor capsule. In fact, endoscopic intrasellar exploration with either 0° or angled lenses allows a more accurate distinction between normal pituitary tissue and the tumor capsule. Furthermore, in the case of suprasellar lesions, the close-up endoscopic view contributes importantly to the dissection of the cyst capsule away from surrounding neurovascular structures. For the cysts with an intrasellar component, which may be adherent to the pituitary gland, we empty the cyst and perform only a partial removal of the capsule, to try to preserve pituitary function.

Study limitations This study is limited by the fact that it is a retrospective experience from three different centers using somewhat different techniques and the data are largely descriptive. Additionally, because there was no direct compar-

ison between the traditional microscopic and endoscopic procedures, we have actually no data to demonstrate that endoscopy provides a measurable difference in outcome as compared to the microsurgical transsphenoidal technique, and therefore, it is not possible to definitively and objectively prove the superiority of endoscopic visualization in these cases. Nonetheless, this study does show that use of the endoscope for such cystic parasellar lesions is safe and effective, and it is clear that the endoscope provides important intraoperative data that are not obtainable with the tunnel vision of the microscope.

Conclusions

The evacuation of cystic sellar lesions typically leaves a residual cavity that can be readily explored with a 0° endoscope. The panoramic endoscopic visualization allows one to assess the completeness of lesion removal, identify of small CSF leaks from the suprasellar cistern, and potentially allows one to perform surgical maneuvers within the sella in a safer and fully visualized fashion than with the tunnel vision afforded by the operating microscope. The findings of this series suggest that the endoscope can be used alone or in a complimentary fashion with the microscope to better explore such cystic lesions. The endoscope was found most helpful in cases of arachnoid cyst to visualize the site of communication with the subarachnoid space, and in cystic pituitary adenomas to identify and remove tumor remnants within folds of a redundant diaphragma sellae or remnants still elevated with a nondescended suprasellar tumor extension. Although this study is limited due to its retrospective nonrandomized nature, the results suggest that endoscopic exploration of cystic sellar and suprasellar lesions provides both general and specific advantages that may improve the efficacy of transsphenoidal lesion removal.

References

1. Alfieri A, Schettino R, Tarfani A, Bonzi O, Rossi GA, Monolo L (2002) Endoscopic endonasal removal of an intra-suprasellar Rathke's cleft cyst: case report and surgical considerations. Minim Invasive Neurosurg 45:47–51
2. Baskin DS, Wilson CB (1984) Transsphenoidal treatment of non-neoplastic intrasellar cysts. A report of 38 cases. J Neurosurg 60:8–13
3. Cappabianca P, Cavallo LM, de Divitiis E (2004) Endoscopic endonasal transsphenoidal surgery. Neurosurgery 55:933–940 (discussion 940–931)
4. Carrau RL, Jho HD, Ko Y (1996) Transnasal-transsphenoidal endoscopic surgery of the pituitary gland. Laryngoscope 106:914–918
5. Cohan P, Foulad A, Esposito F, Martin NA, Kelly DF (2004) Symptomatic Rathke's cleft cysts: a report of 24 cases. J Endocrinol Invest 27:943–948
6. de Divitiis E, Cappabianca P, Cavallo LM (2003) Endoscopic endonasal transsphenoidal approach to the sellar region. In: de Divitiis E, Cappabianca P (eds) Endoscopic endonasal transsphenoidal surgery. Springer, New York, pp 91–130
7. de Divitiis E, Spaziante R, Stella L (1981) Empty sella and benign intrasellar cysts. In: Krayenbühl H (ed) Advances and technical standards in neurosurgery. Springer, New York, pp 3–74
8. el-Mahdy W, Powell M (1998) Transsphenoidal management of 28 symptomatic Rathke's cleft cysts, with special reference to visual and hormonal recovery. Neurosurgery 42:7–16 (discussion 16–17)
9. Fahlbusch R, Honegger J, Paulus W, Huk W, Buchfelder M (1999) Surgical treatment of craniopharyngiomas: experience with 168 patients. J Neurosurg 90:237–250
10. Frank G, Sciarretta V, Mazzatenta D, Farneti G, Modugno GC, Pasquini E (2005) Transsphenoidal endoscopic approach in the treatment of Rathke's cleft cyst. Neurosurgery 56:124–128 (discussion 129)
11. Iqbal J, Kanaan I, Al Homsi M (1999) Non-neoplastic cystic lesions of the sellar region presentation, diagnosis and management of eight cases and review of the literature. Acta Neurochir (Wien) 141:389–397 (discussion 397–388)
12. Jho HD, Carrau RL, Ko Y (1996) Endoscopic pituitary surgery. In: Wilkins H, Rengachary S (eds) Neurosurgical operative atlas. American Association of Neurological Surgeons, Park Ridge, pp 1–12
13. Kaptain GJ, Vincent DA, Sheehan JP, Laws ER Jr (2001) Transsphenoidal approaches for the extracapsular resection of midline suprasellar and anterior cranial base lesions. Neurosurgery 49:94–101
14. Kern EB, Laws ER (1982) The rationale and technique of selective transsphenoidal microsurgery for the removal of pituitary tumors. In: Laws ER, Randall RV, Kern EB, Abboud CF (eds) Management of pituitary adenomas and related lesions with emphasis on transsphenoidal microsurgery. Aplleton-Century-Crofts, New York
15. Laws ER Jr (1980) Transsphenoidal microsurgery in the management of craniopharyngioma. J Neurosurg 52:661–666
16. Laws ER Jr (1994) Transsphenoidal removal of craniopharyngioma. Pediatr Neurosurg 21(Suppl 1):57–63
17. Laws ER, Weiss MH, White WL (2003) Craniopharyngioma. Skull Base 13:55–58
18. Locatelli D, Levi D, Rampa F, Pezzotta S, Castelnuovo P (2004) Endoscopic approach for the treatment of relapses in cystic craniopharyngiomas. Childs Nerv Syst 20:863–867
19. Marks MP, Chee H, Liddell RP, Steinberg GK, Panahian N, Lane B (1994) A mechanically detachable coil for the treatment of aneurysms and occlusion of blood vessels. AJNR Am J Neuroradiol 15:821–827
20. Midha R, Jay V, Smyth HS (1991) Transsphenoidal management of Rathke's cleft cysts. A clinicopathological review of 10 cases. Surg Neurol 35:446–454
21. Oskouian RJ, Samii A, Laws ER Jr (2006) The craniopharyngioma. Front Horm Res 34:105–126
22. Saeki N, Tokunaga H, Hoshi S, Sunada S, Sunami K, Uchino F, Yamaura A (1999) Delayed postoperative CSF rhinorrhea of intrasellar arachnoid cyst. Acta Neurochir (Wien) 141:165–169
23. Shin JL, Asa SL, Woodhouse LJ, Smyth HS, Ezzat S (1999) Cystic lesions of the pituitary: clinicopathological features distinguishing craniopharyngioma, Rathke's cleft cyst, and arachnoid cyst. J Clin Endocrinol Metab 84:3972–3982
24. Smith AR, Elsheikh TM, Silverman JF (1999) Intraoperative cytologic diagnosis of suprasellar and sellar cystic lesions. Diagn Cytopathol 20:137–147

25. Spaziante R, de Divitiis E (1997) Drainage techniques for cystic craniopharyngiomas. Neurosurg Quart 7:183–208
26. Spaziante R, de Divitiis E, Stella L, Cappabianca P, Donzelli R (1981) Benign intrasellar cysts. Surg Neurol 15:274–282
27. Teo C (2005) Application of endoscopy to the surgical management of craniopharyngiomas. Childs Nerv Syst 21:696–700
28. Van Effenterre R, Boch AL (2002) Craniopharyngioma in adults and children: a study of 122 surgical cases. J Neurosurg 97:3–11
29. Weber EL, Vogel FS, Odom GL (1970) Cysts of the sella turcica. J Neurosurg 33:48–53
30. Yoshida J, Kobayashi T, Kageyama N, Kanzaki M (1977) Symptomatic Rathke's cleft cyst. Morphological study with light and electron microscopy and tissue culture. J Neurosurg 47:451–458
31. Zada G, Kelly DF, Cohan P, Wang C, Swerdloff R (2003) Endonasal transsphenoidal approach for pituitary adenomas and other sellar lesions: an assessment of efficacy, safety, and patient impressions. J Neurosurg 98:350–358

Comments

Philippe Decq, Creteil, France

For a few years, endoscopic surgery has tended to replace the use of the microscope in the management of pituitary adenomas. The quality of the endoscopic vision makes it possible to identify easily the anatomy of the nasal fossa, therefore to limit the traumatism of the surgical approach. The immediate postoperative period is somewhat improved for the benefit of the patients, surgery becoming really "minimally invasive." The good visualization of the posterior and lateral walls of the sphenoid sinus makes it possible to optimize the opening of the sellar floor with a good control of its limits, better than could do the use of the microscope. The additional contribution of endoscopy is the possibility to inspect the sellar cavity during and at the end of the surgery, in particular, with 30° telescopes to complete the surgical removal in "blind" zones for the microscope. This last stage is particularly conclusive for cystic lesions as brilliantly shown by the internationally well-known experts of this paper. As the authors recognize it, it is a descriptive, retrospective, and not randomized study, not bringing the scientific proof of the "superiority" of the endoscope on the microscope in the surgery of these cystic lesions. Such a scientific work remains to be made but will not be easy. However, the quality of the images shown in this paper speaks by their own. The surgery is linked to vision. It is an act carried out under control of the view. And all the surgeons having great experience in pituitary surgery know very well that the microscope does not allow a perfect visualization of the sellar cavity, in particular, of the lateral walls, and also of the superior wall when there is a suprasellar extension. It is the interest of the endoscope, in particular, with an oblique vision (as this paper shows it), which makes it possible to clearly visualize a lateral remnant or a communication with the suprasellar subarachnoid spaces. As also underlined by the authors, the inspection of the sellar cavity is not always simple. We should sometimes use additional tricks to reach the goal: Irrigation can wash a bleeding; a lumbar drainage can limit the descent of the diaphragm (moving the patient to a more "sitting" position can also do it). The only small point of disagreement that I can have with the authors is the little of interest which I find with the use of 0° telescope when one knows the panoramic field offered by a 30° telescope which can be used during all the procedure. This work adds a stone to the building, to show the undeniable interest of the endoscopy in the surgery of cystic lesions of the sellar region.

Kaoru Kurisu, Hiroshima, Japan

In this paper, the authors precisely described how to manage or control cystic lesion in and around sella turcica using the endoscope. The most beneficial point of using an endoscope in this area is to disclose direct operative view in the blind corner under the microscope in the suprasellar and lateral extension of the lesion, especially using an "angled" rigid-type endoscope. For suprasellar extension, usually we use 30° optics, but for upright or frontal extension, we use 70° type to catch direct and panorama view of the operative field. The other main benefit of using the endoscope is to observe the inner surface of the cystic lesion. Sometimes compressed and extremely thinned, the normal pituitary gland and pituitary stalk can be observed clearly from inside of the cyst after evacuation of the cyst content. Therefore, we can do meticulous management to keep and maintain the pituitary function. If we remove partially the lesion, suprasellar part can be easily descended and obliterate the route to reach the residual suprasellar part. For that situation, in our department, in the case of amount of suprasellar extension, before positioning of the patient, we set spinal drainage. After partial removal, residual part is going down, and then we have to aspirate CSF from spinal drainage slowly under observing the upward moving of the residual part. After this maneuver, the folded diaphragma sellae and residual part can be raised to open the surgical route to reach the upper part. And of course, we inject saline or ringer solution to push down the residual part of the lesion after partial removal when the lesion cannot go down.

Nowadays, endoscope assistance or endoscopic procedure in this area is crucial for safe and satisfied operation not only for the surgeon but also for the benefit and good result of the patient himself.

Theodore H. Schwartz, New York, USA

As the endoscope gradually makes its way into general neurosurgical practice, surgeons will look to the pioneers of the technique for their experience in a variety of uncommon situations which may be faced infrequently in the community. One such circumstance is the cystic lesion of the sella or sella–suprasellar region. In this valuable, well-illustrated article, three of the centers of excellence in endoscopic transsphenoidal surgery have enlightened us with a variety of operative nuances gleaned over years of experience with cystic sellar lesions. Precious advice about managing premature descent of the suprasellar cistern, adherent Rathke cleft cyst remnants, and craniopharyngioma drainage will prove priceless to the novice and developing practitioner. Cystic lesions ultimately provide an ideal setting for endoscopic navigation based on the cavitary intralesional space which lends itself to angled endoscopic visualization. The images in this article are spectacular and provide incontrovertible evidence of the value of the endoscope over the microscope in sellar surgery.