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Endoscopic management of lesions of the sella turcica

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Abstract

The excellent visualization and minimally invasive surgical technique of endoscopic sinus surgery was applied to the management of 40 patients with sellar lesions. Endoscopic management of sellar lesions offers, not only the advantage of improved visualization, but also magnification, and a panoramic perspective of the important relationships of the sella turcica. In the past year, we have managed 40 subjects with sellar lesions, endoscopically: 38 patients had pituitary adenomas and two a craniopharyngioma.

At our hospital, the endoscope has replaced the operating microscope for surgery for pituitary adenomas and other sellar lesions. The endoscopic approach to the sphenoid sinus and the sella is performed by an ENT surgeon and the ablative surgery performed by a neurosurgeon.

Our experiences, using the endoscope to perform surgery on sellar and parasellar lesions, are reported and the advantages, over the operating microscope, which is traditionally used are discussed. The technique for endoscopic management of sellar lesions is described.

Key words: Hypophysectomy, transphenoidal; Endoscopy

Introduction

The sublabial transseptal–transphenoidal approach to the sella turcica, under microscopic visualization, is the method most commonly used for pituitary adenomas, since this technique was introduced by Hardy (1969). This approach which combines a sublabial with a transfixion incision, was the standard approach, employed for access to the sella turcica, at our hospital. The microscope was routinely used for magnification and illumination.

Having been involved in endoscopic sinus surgery for several years and having applied the endoscopic technique to several sphenoid lesions, it was suggested that endoscopic techniques might be applied to lesions of the sella turcica.

Following a study of the cross-sectional anatomy of the sphenoid sinus and the sella turcica as depicted by computerized tomography (CT) scanning, 30 cadaveric dissections, and an endoscopic study, the endoscopic approach to the sella turcica was used to treat 40 patients with sellar lesions. This report describes the application of the transnasal endoscopic technique, to the management of pituitary adenomas and craniopharyngiomas.

Material and methods

Forty patients with sellar lesions were managed endoscopically between the period November 1993 to October 1994, at the Departments of Otolaryngology and Neurosurgery, Singapore General Hospital. Thirty-eight had a pituitary adenoma and two were diagnosed as having a sellar craniopharyngioma. The transnasal–transsphenoidal endoscopic technique was used in managing these patients. The technique provided excellent visualization of the structures within the sphenoid sinus, i.e. the optic nerve, optic chiasma, internal carotid artery, and the sella turcica.

Technique

The surgery was performed under general anaesthesia. Oral endotracheal intubation was used and a pharyngeal pack placed in the pharynx. A spinal catheter, in the subarachnoid space, may be used, depending upon individual assessment of the patient. The patient was positioned supine on the operating table with the head elevated to 40°. The nasal cavity was decongested with a topical application of four per cent cocaine, and local infiltration of one per cent lidocaine with 1:80 000 epinephrine. Particular attention was given to the sphenoethmoid recess and the anterior wall of the sphenoid.

The surgical team comprised an ENT surgeon, and a neurosurgeon. Access was provided by the ENT surgeon and the ablative surgery performed by the neurosurgeon.

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A three-chip videocamera was attached to the eyepiece of the telescope and the entire procedure monitored on a 14 inch high resolution RGB videomonitor and recorded on a super-VHS videotape for documentation. An image intensifier and fluoroscope were kept on stand-by and used to determine the intrasellar location of the telescope, or the instruments, during the procedure.

Two approaches were employed for access to the sphenoid sinus and the sella turcica. These were: (1) endoscopic transnasal–transseptal approach; and (2) endoscopic transethmoid approach.

Transnasal–transseptal approach

The transnasal–transseptal approach was performed by making a hemitransfixion incision and extending it onto the floor of the nose. A mucoperichondrial flap was elevated from the septal cartilage, and extended posteriorly to reveal the bony septum. The mucoperiostium was elevated from the floor of the nose. Both tunnels were connected by dividing the bony-cartilaginous intersection. The quadrilateral cartilage was then disarticulated from the maxillary crest to allow the cartilage to be displaced. The bony-cartilaginous junction with the perpendicular plate of the ethmoid was disarticulated next and the bilateral posterior mucoperiosteal flaps were elevated back to the sphenoid rostrum. The bony septum, consisting of the vomer and perpendicular plate of the ethmoid, was then removed as a large piece as it might be needed later, to aid in the closure of the sphenoid rostrum.

The mucosa was then elevated from the face of the sphenoid. At this point, a small self-retaining sphenoid retractor was inserted without resorting to an alar-releasing incision, to allow placement of the self-retaining retractor, in any of the 40 cases, although, occasionally, it might be necessary. The sphenoid rostrum was now in full view. A 0° 4 mm telescope with a videocamera was introduced. Under endoscopic visualization, using a high resolution 14 inch videomonitor, a sphenoidotomy was made close to the rostrum and enlarged, as far laterally as the sphenoid ostia, using a Kerrison sphenoid punch. A sufficiently large sphenoidotomy was made to allow easy passage of the 4 mm telescope and the instruments (Figure 1).

The sphenoid cavity was examined with 0°, 30° and 70° telescopes. The location of the anatomical landmarks within the sphenoid were noted. The internal carotid arteries, the optic nerves, optic chiasma, intersinus septae, and the sella turcica were of particular importance. The bony septa may have to be removed at this point. However, extreme caution was exercised as they often terminate on the carotid canal. Care was, also, taken not to strip the sphenoid mucosa as this could result in considerable bleeding. Once a panoramic view of the entire sphenoid cavity, and the surgical landmarks was obtained, the access to the sella turcica was complete.

Further surgery was performed by the neurosurgeon. The surgical procedure was performed by observing it on a high resolution 14 inch videomonitor. A Freer elevator was used to eggshell fracture the back wall of the sphenoid and a small backbiting rongeur or a 2 mm Kerrison punch was used to delicately remove the bone overlying the dura. Bipolar diathermy was used for haemostasis over the dura before incising it. The pituitary tumour was removed using a combination of blunt ring curettes and pituitary forceps.

A 30° 4 mm or 2.7 mm telescope was used at this point, to examine the lateral and superior reaches of the sella turcica for any residual tumour, CSF leak, or dural defect. The surgeon's intention was to leave behind an intact tumour capsule. A small tumour capsule defect, without any CSF leak, was managed by plugging the sella with Surgicel and fibrin glue. If a CSF leak was recognized intraoperatively, the sphenoid cavity was plugged with abdominal fat and fibrin glue, and the sphenoid rostrum defect reconstructed with a small piece of bone from the vomer to prevent the fat from herniating into the mucosal layers. Any one of several methods described for closure of CSF leaks could be used (Wigand, 1981; Papay *et al.*, 1989; Stankiewicz, 1989). Closure involved reattachment of the caudal end of the septal cartilage to the maxillary spine. The mucosal layers were replaced in their original position and the incision closed with interrupted sutures. Silicone intranasal splints were placed lateral to the nasal septum and the nasal cavity packed with Merocel in a latex finger stall. The

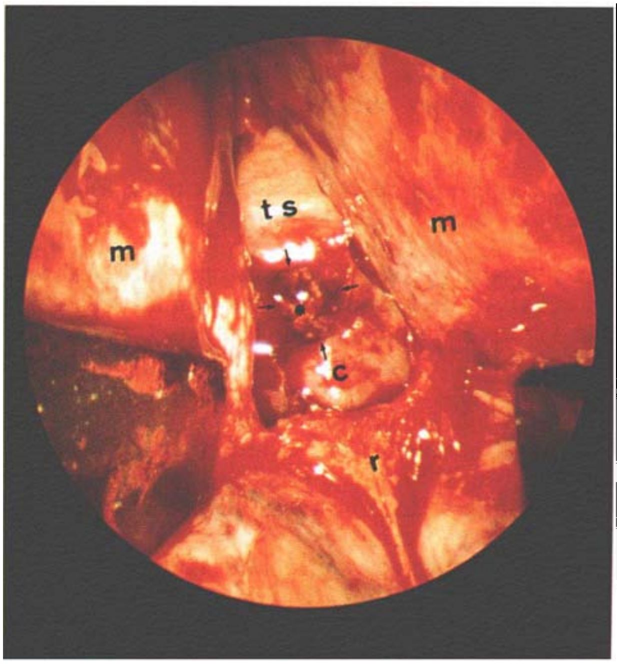

FIG. 1

Transseptal–transsphenoidal approach to the sella. Sphenoid rostrum has been removed to reveal intrasphenoidal structures (endoscopic view using 0° 4 mm telescope). m = mucoperiosteal flaps of the nasal septum; r = inferior remnant of sphenoid rostrum; ts = tuberculum sella; c = clivus; small arrows indicate opening in the anterior wall of sella; asterisk indicates tumour tissue.

Merocel was removed after 24–48 hours, and the intranasal splints on the fifth post-operative day.

Endoscopic transethmoid approach

The patient was prepared for the operation in an identical way to that described for the endoscopic transseptal approach. Intranasal endoscopic ethmoidectomy was performed as described by Kennedy (1985). Care was taken to identify the anterior sphenoid wall before performing a sphenoidotomy. The posterior ethmoidal neurovascular bundle and the sphenoid ostium were used as landmarks. It was essential to trim the middle turbinate, as this manoeuvre, not only provided excellent access to the sphenoethmoid recess, but also, aided post-operative tumour surveillance. The sphenoid ostium can then be readily identified, and enlarged to remove the entire anterior wall of the sphenoid, gaining access to the sphenoid. A sufficiently large sphenoidotomy was necessary, to allow the passage of the 4 mm telescope, into the sphenoid along with the pituitary forceps and curettes. Once the transethmoid access to the sphenoid was complete, further surgery was similar to that described for the transseptal approach.

If no CSF leak was seen intraoperatively, the sella was plugged with Surgicel, and the anterior sellar wall defect closed with a small piece of bone from the middle turbinate. The sphenoidotomy defect was left open, and provided a window for tumour surveillance. However, if a CSF leak was identified intraoperatively, the sphenoid cavity was plugged with abdominal fat and fibrin glue. It may be necessary to close the anterior sphenoid wall defect with a small piece of middle turbinate. The ethmoid cavities were packed with Merocel placed in latex finger stalls which were removed on the fifth post-operative day.

Patients (see Table I)

Patient 1

A 50-year-old, Chinese, female presented with left epistaxis. An endoscopic examination showed stale blood in the left sphenoethmoid recess. CT scan and MRI evaluation showed a sellar lesion encasing the cavernous sinus and eroding the sella into the left side of the sphenoid sinus (Figure 2). A biopsy of the lesion was obtained using a left endoscopic trans-ethmoid–transsphenoid approach to the sella (Figure 3). A pituitary adenoma was reported. A month later, after endocrine assessment, an endoscopic hypophysectomy was performed (Figure 4). The earlier approach, and a wide sphenoidotomy, provided a ready access for endoscope placement and instrumentation and also provided excellent endoscopic tumour surveillance.

Patient 2

A 53-year-old, Chinese, gentleman, on MRI screening for left sensorineural hearing loss, was noted to have an incidental sellar lesion (Figure 5). As the lesion was predominantly unilateral, the sella was approached through a transethmoid sphenoidotomy. The presence of an Onodi cell in this patient demonstrated its close relationship with the optic nerve (Figure 6). Excellent visualization of the optic nerve with the telescope enabled careful removal of the anterior sphenoid wall medial to it. Considerable inferior removal of the anterior sphenoid wall was necessary in this patient to obtain a sufficiently large-sized sphenoidotomy. The bony anterior sellar wall was removed with a Blakesley–Wilde forceps to expose the capsule of the tumour.

A biopsy was obtained on opening the capsule. There was no CSF leak and the mild bleeding was controlled with Surgicel. A pituitary adenoma was reported. The patient subsequently underwent an uneventful endoscopic transethmoid–transsphenoidal hypophysectomy.

Patient 3

A 47-year-old diabetic, Chinese female, presented with a sellar lesion and a suprasellar extension (Figure 7). As the tumour was mainly midline a transnasal–transseptal approach was used. A sufficient midline spenoidotomy allowed for 4 mm endoscope placement and instrumentation. The anterior sellar wall and dura were opened as described in **Methods**. The pituitary tumour was removed and frozen section confirmed a pituitary adenoma. It was possible to advance the 4 mm telescope into the tumour capsule for visualization of any remains of the tumour. A CSF leak was recognized intraoperatively and controlled by reduction of CSF pressure with a lumbar subarachnoid drain for five days.

Discussion

A review of pituitary surgery shows two major developments, that have reduced the morbidity associated with this surgery. The first was the development of the transsphenoidal route, which provided direct access to the sella without a craniotomy. The second was an improvement in illumination and magnification using the operating microscope. The transsphenoidal route for surgery of sellar lesions has been used since 1907 (Schloffer, 1907). However, this approach fell into disfavour, because of the high incidence of complications and because of the difficulty in operating through a deep narrow exposure with poor illumination. The introduction of the operating microscope, a few decades later, provided improved illumination and magnification. In 1958, Guiot introduced radiofluroscopy to visualize the depth and position of the surgical instruments intraoperatively (Guiot, 1973). The operating microscope, combined with radiofluroscopy, afforded the possibility of a safer operation, and became the standard approach for the majority of the sellar lesions.

Several modifications with which to approach the sphenoid sinus were subsequently described (Tucker

TABLE I
PATIENT PROFILE, DIAGNOSIS, AND ENDOSCOPIC TRANSSPHENOIDAL APPROACH TO THE SELLA TURCICA

Patient	Age/Sex	Race	Diagnosis	Approach
1	50/F	Chinese	Pituitary adenoma	Transethmoid
2	54/M	Chinese	Pituitary microadenoma	Transethmoid
3	32/M	Chinese	Pituitary adenoma	Transseptal
4	39/F	Chinese	Craniopharyngioma	Transethmoid
5	38/M	Chinese	Craniopharyngioma	Transethmoid
6	37/M	Indian	Pituitary adenoma	Transseptal
7	37/M	Chinese	Pituitary adenoma	Transseptal
8	35/F	Chinese	Pituitary adenoma	Transseptal
9	44/F	Chinese	Pituitary adenoma	Transseptal
10	48/M	Chinese	Pituitary microadenoma	Transseptal
11	54/M	Chinese	Pituitary adenoma	Transseptal
12	41/F	Malay	Pituitary adenoma	Transseptal
13	43/M	Indian	Pituitary adenoma	Transseptal
14	33/F	Chinese	Pituitary microadenoma	Transseptal
15	57/F	Chinese	Pituitary adenoma	Transseptal
16	56/F	Chinese	Pituitary adenoma	Transseptal
17	43/F	Chinese	Pituitary adenoma	Transseptal
18	76/F	Chinese	Pituitary adenoma	Transseptal
19	67/F	Malay	Pituitary adenoma	Transseptal
20	62/M	Chinese	Pituitary adenoma	Transseptal
21	60/F	Chinese	Pituitary adenoma	Transseptal
22	58/F	Chinese	Pituitary adenoma	Transseptal
23	37/F	Malay	Pituitary adenoma	Transseptal
24	56/F	Chinese	Pituitary adenoma	Transseptal
25	48/F	Chinese	Pituitary adenoma	Transseptal
26	37/M	Chinese	Pituitary adenoma	Transseptal
27	48/F	Chinese	Pituitary adenoma	Transseptal
28	40/F	Chinese	Pituitary adenoma	Transseptal
29	30/M	Chinese	Pituitary adenoma	Transseptal
30	40/M	Chinese	Pituitary adenoma	Transseptal
31	42/M	Chinese	Pituitary adenoma	Transseptal
32	48/F	Chinese	Pituitary adenoma	Transseptal
33	39/F	Chinese	Pituitary adenoma	Transseptal
34	59/F	Chinese	Pituitary adenoma	Transseptal
35	62/F	Chinese	Pituitary adenoma	Transseptal
36	45/M	Chinese	Pituitary adenoma	Transseptal
37	68/M	Chinese	Pituitary adenoma	Transseptal
38	27/M	Chinese	Pituitary adenoma	Transseptal
39	44/M	Chinese	Pituitary adenoma	Transseptal
40	27/M	Chinese	Pituitary adenoma	Transseptal

and Hahn, 1982; Koltai *et al.*, 1985; Wilson *et al.*, 1990). The sublabial transseptal–transsphenoidal approach has been favoured, because of the safety of the midline approach, in addition to affording, equal access to both sides of the sphenoid and sella. In the past decade, the role of endoscopes in the diagnosis and management of nasal and paranasal sinuses has been firmly established. As surgeons gain familiarity with endoscopes and endoscopic anatomy of the nose and paranasal sinuses, the use of endoscopes, beyond the paranasal sinuses, will be a logical progression.

Advantages of the endoscopic technique

The endoscope provides better illumination, magnification and visualization, than the operating microscope. In addition endoscopes have the advantage of angled vision and a panoramic perspective. All these factors are crucial to the safety of the surgical procedure and several complications associated with the standard approach can be avoided using the endoscope.

Complications such as arterial haemorrhage, visual loss, extra-ocular palsies, occurring in the course of transsphenoidal surgery have been described (Laws and Kern, 1976; Black *et al.*, 1987; Reddy *et al.*, 1990). These have been attributed to carotid artery and cranial nerve injury in the para- and suprasellar areas and result from poor visualization of structures in the sphenoid sinus, as the microscope provides only a singular line of vision of the sella turcica. Thus, the risk of trauma to these structures can be minimized with the accurate visualization and precision, provided by the endoscope. Surgery on the sella can be performed equally well, and in particular cases, perhaps more accurately using endoscopic visualization.

In addition to improved illumination and visualization the potential advantage of endoscopic instrumentation also includes the ability to use angled telescopes to visualize what would otherwise be blind corners to the singular line of vision of the operating microscope. The smaller size of the endoscopic equipment compared to the microscope, and the ability to quickly change the field of

FIG. 2

Pre-operative gadolinium enhanced MRI scan of patient no. 1 with pituitary adenoma showing sellar erosion (asterisk) and encasement of the cavernous sinus (arrowed).

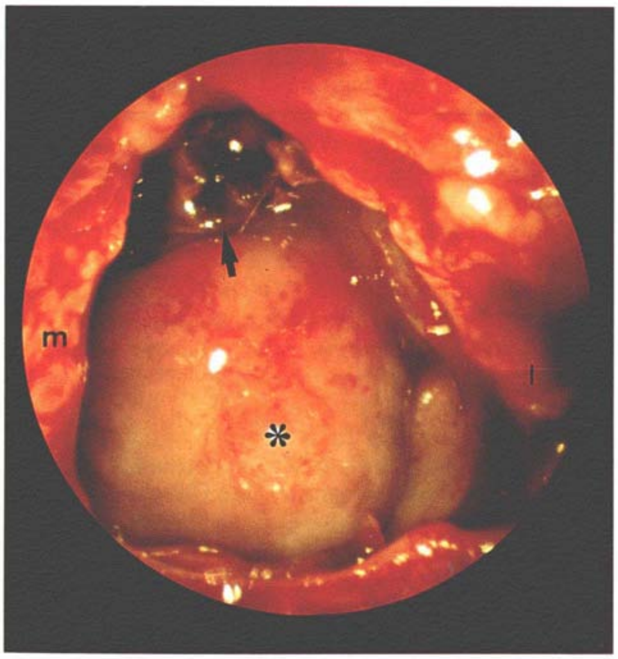

FIG. 3

Endoscopic view (using 0° 4 mm telescope) of the sellar lesion (asterisk) in patient no. 1 at time of the endoscopic biopsy which was reported as a pituitary adenoma. Tissue (arrowed) was reported as an infarcted pituitary adenoma. m = medial; l = lateral.

view between close-up and more panoramic perspectives allows for constant monitoring of important surgical landmarks reducing the morbidity and increasing the safety of the procedure.

Disadvantages of the endoscopic approach

Potential disadvantages of endoscopic surgery include the lack of binocular viewing, and subsequent lack of depth of field. However, depth perspective can be achieved by visual and tactile feedback, obtained while moving the telescope slightly in and out, together with palpation of structures with an instrument under endoscopic monitoring. This disadvantage is offset by the magnification and wider field of view available using an endoscope, as the field of view of the microscope is limited to the width of the defect in the face of the sphenoid.

The other disadvantage is the potential require-

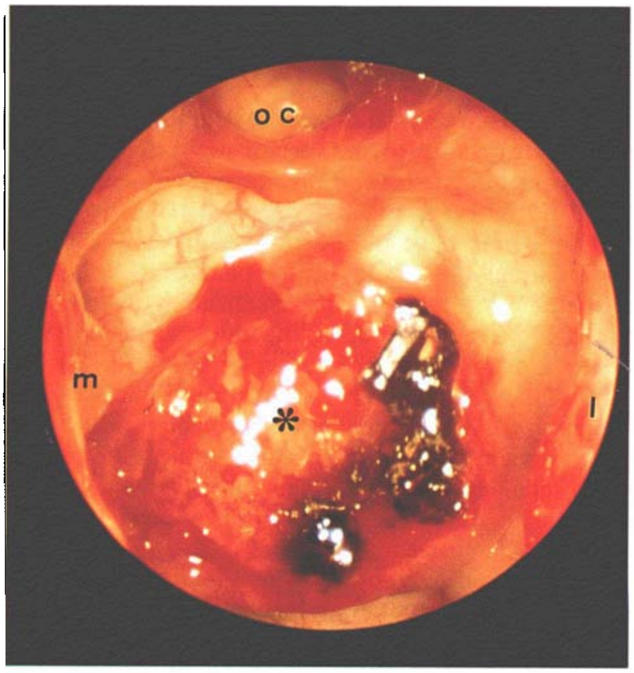

FIG. 4

Endoscopic view (using 0° 4 mm telescope) of the sella (asterisk) two weeks post-operatively. Note complete removal of tumour tissue. oc = Onodi cell; m = medial; l = lateral.

FIG. 5

Pre-operative gadolinium enhanced MRI scan of patient no. 2 revealing a sellar lesion (small asterisk). Small arrow points to internal carotid artery. Large arrow indicates optic chiasma.

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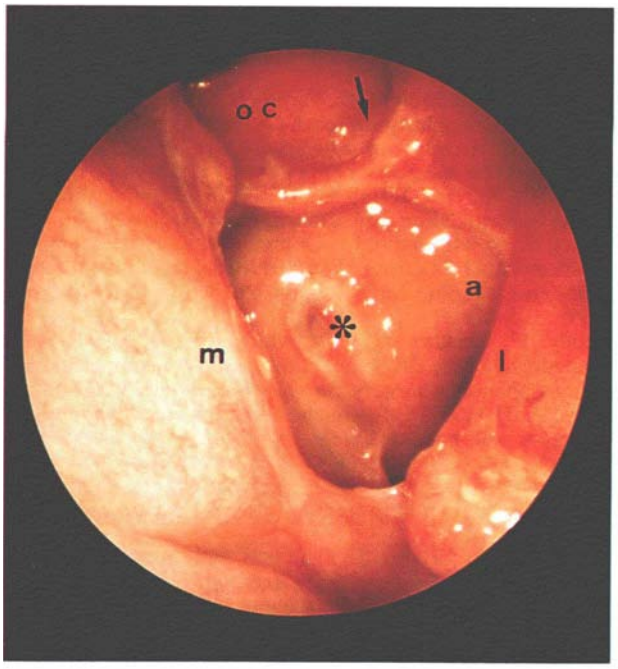

FIG. 6

Endoscopic view (using 0° 4 mm telescope) of sellar lesion (asterisk) of patient no. 2 at the time of endoscopic biopsy. Arrow indicates optic nerve. Note the relationship of the Onodi cell to the optic nerve. m = medial; l = lateral; oc = Onodi cell; a = internal carotid artery bulge.

ment of an alar-releasing incision to allow room for placement of the self-retaining speculum, particularly, when a transseptal approach is used. This incision was avoided in all the patients described in this paper.

Minimally invasive approach

The endoscopic transnasal–transseptal approach is a minimally invasive approach. It avoids a sublabial incision which may result in a numb lip, and dental injury. It also avoids the anterior nasal spine, the alteration of which may lead to a change in the external appearance of the nose.

Endoscopic transseptal–transsphenoidal approach

This approach is suitable for midline sellar lesions. It requires no external incision, other than a hemitransfixion incision, on the membraneous nasal septum, and is not disruptive to nasal anatomy. As most pituitary tumours are midline, this approach is commonly used.

Endoscopic transethmoidal–transsphenoidal approach

The transethmoid approach is used when the lesion is predominantly unilateral and offers the advantage of tumour surveillance, during the post-operative follow-up, through the large sphenoidotomy created. However, it has the disadvantage of being disruptive to the nasal anatomy, as an

FIG. 7

Pre-operative T_1-weighted, gadolinium enhanced MRI scan of patient no. 3. Note the suprasellar extension (arrows).

ethmoidectomy is performed to gain access to the sphenoid sinus.

Of the 40 patients who underwent endoscopic hypophysectomy, in this series, 38 had a pituitary adenoma, and two a craniopharyngioma. The endoscopic transseptal approach was used for 36 patients, and the transethmoid approach for four. All our patients tolerated the procedure well. There were no major intraoperative or early post-operative complications, resulting from the change in technique from the operative microscope to the endoscope.

Intraoperative bleeding was not significant. Pre-operative nasal preparation with cocaine and 1:80 000 epinephrine, the use of bipolar diathermy on the tumour capsule and the dura prior to incising it, and taking the precaution of not stripping the sphenoid mucosa, were the key points in reducing intraoperative bleeding. Excellent visualization of the neural structures during the surgery avoided any neurological complications in these patients.

Surgicel and Tissel® fibrin glue was used to plug the sella, when a CSF leak was not obvious intraoperatively. In the event of a CSF leak being recognized, the sphenoid sinus was, additionally, plugged with abdominal fat and fibrin glue. A piece of vomer was used to reconstruct the sphenoid rostrum. Despite these measures, two of our initial patients, developed a mild CSF leak post-operatively. These patients required endoscopic re-exploration, repair of the leak, and placement of a lumbar catheter in the subarachnoid space (for CSF drainage) for five days.

Long-term follow-up results are not available. The follow-up period, in patients in this series, ranges from two to 14 months. We have seen one recurrence in a patient with a cystic sellar lesion. The cyst recurred six months after the first aspiration. As a transethmoid approach had been used, in this patient, the wide sphenoidotomy provided a ready access for repeat aspiration. She has remained well.

Conclusions

Endoscopic management of sellar lesions has definite advantages over that of the operating microscope. Endoscopes offer improved visualization, angled view, and a wider panoramic perspective of the important anatomical relationships of the sphenoid and the sella turcica and should be included in the future armamentarium for future pituitary surgery.

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