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Endoscopic and microscopic paraseptal transsphenoidal approach to the sella turcica*

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SUMMARY

Objectives: *To establish the feasibility of the paraseptal approach to the sella and to demonstrate the superiority of the endoscopic over the microscopic vision during pituitary surgery.*

Study design: *Prospective monocentric study.*

Methods: *Nine consecutive patients with a pituitary tumour were operated since November 2002. The surgical procedure consisted of a paraseptal approach of the sella with use of a rigid endoscope. Pre- and postoperative (3 months after surgery) symptoms, Magnetic Resonance Imaging (MRI) findings, endocrine and ophthalmic assessment, and intraoperative findings were recorded.*

Results: *One patient presented a CSF leak with a successful peroperative repair. Regarding symptom resolution, headache disappeared during the early postoperative period in case of pituitary apoplexy. All cases of preoperative hemianopsia and diplopia but one improved significantly. Two patients recovered preoperative deficient hormonal functions and six patients did not require substitution therapy any more. No nasal packing was needed except in one case. Considering the healing course, the mucosa repair inside the sphenoid sinus was quicker with Surgicel® removal at week 4. Postoperative MRI demonstrated a residual parasellar nodule in 3 out of 6 cases of macroadenoma. Only one required radiation therapy. These results are commented through comparison with the transseptal approach and with surgery exclusively using the microscope.*

Conclusions: *The paraseptal transsphenoidal approach to the sella turcica using the telescope is at least as effective as the conventional transseptal approach using the operating microscope only. It provides a wide access to the pituitary fossa and an optimal vision of the critical areas. The absence of postoperative nasal packing improves significantly the comfort of the patient during the first postoperative hours.*

Key words: sinus surgery, endoscopy, operating microscope, pituitary tumour, paraseptal approach, complications

INTRODUCTION

Surgery for pituitary tumours evolves rapidly since its initial description during the first decade of the 20th century [1,2]. The major changes observed the last years mainly concern development of new surgical approaches [3-5] or instrumentation leading to clearly reduced surgical invasiveness [6]. Today, the extracranial transsphenoidal approach is a well-established neurosurgical procedure and is regarded as the golden standard for the vast majority of benign pituitary tumours. Surgery can be conducted through one or both nostrils, using a self-retained retractor and the operating microscope [7-11] or rigid telescopes being linked to a TV monitor [12-14].

In this study, the nasal approach to the sella is performed by a rhinologist and the resection of the adenoma is carried out by a neurosurgeon. Until October 2002, we used the conventional transseptal transsphenoidal approach using exclusively an operating microscope. Since November 2002, we have been using a paraseptal transsphenoidal approach combining the use of endoscopic and microscopic vision.

This paper describes the different phases of the surgical procedure and analyses the postoperative functional and anatomical results. A comparison with the transseptal approach is proposed. The advantages and drawbacks of the paraseptal transphenoidal approach are discussed.

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PATIENTS AND METHOD

Study design

This study was prospective and monocentric including 9 patients operated via a paraseptal transsphenoidal approach from November 2002 to July 2003.

Inclusion and preoperative data

At baseline (before surgery), a full medical history, examination and investigations were done to ensure eligibility for the study. The patients were informed about the surgical procedure and the potential risks of the surgery. The preoperative examinations consisted of nasal endoscopy, imaging, ophthalmic and endocrine assessment. The nasal endoscopy occurred with use of 0° and 30° telescopes. Imaging of the sphenoid region was performed with Magnetic Resonance Imaging (MRI).

Surgical technique

The procedure was carried out under general anaesthesia using an oral endotracheal tube. The patient was placed in a supine and anti-Trendelenburg position. The head was in a Mayfield horseshoe headrest, lifted up and rotated 15° to the right so that it faces the surgeon. A TV monitor was placed in front of him allowing all the staff in the operating room to take part to the different phases of the procedure.

After induction of the general anaesthesia, neurosurgical pledgets soaked with 5% lidocaine and a 0.02% dilution of naphazoline hydrochloride were inserted through a nasal speculum as far posterior as possible in each nostril. They were left in place for 20 minutes.

After removal, the anterior end of the middle turbinates and the bony septum were infiltrated with a 1% lidocaine solution and 1:100,000 dilution of adrenaline. A sphenoidotomy was performed on both sides using a 4 mm rigid 0° telescope. It was enlarged with a bone rongeur down to the sphenoid floor, medially to the sphenoid rostrum and as laterally as possible keeping in mind the anatomic variations in the relationships between the optic nerve and the Onodi cell. The nasal mucoperiosteum was elevated from the bony septum, anterior to the sphenoid rostrum and resected. With a straight curette, the perpendicular plate of the ethmoid bone was dislocated from the cartilaginous septum and removed from forward to backward with a Blakesley forceps. The remaining part of the anterior wall of the sphenoid sinuses and the intersinus septum were also resected with a Kerrison forceps. The sphenoid rostrum was taken away using a chisel and the hammer making wide the access to the sella turcica and the posterior wall of the sphenoid sinus.

The following steps were then performed by the neurosurgeon, first, under endoscopic guidance. In most of the cases, the 30° telescope, manipulated by the ENT specialist, was inserted in the right nasal fossa while the instruments were manipulated through the left nasal fossa. In case of severe septal deviation, both of them were manipulated in the most patent nasal cavity. The floor of the sella turcica was completely removed with a Kerrison forceps (Figure 1). The dura mater was incised with the sickle knife in a conventional cruciform fashion. The adenoma was removed using suction tubes, microdissectors and angulated curettes.

At this moment, the neurosurgeon used the operating microscope to check the tumour resection and to complete it if needed. In one case he did not use the microscope but the telescope only. At the end of the surgery, the sella and the sphenoid sinuses were plugged with a mixture of fibrin glue and Surgicel® (Absorbable Haemostat: oxidised regenerated cellulose –ETHICON). Fibrin glue was also put on the edges of the removed nasal septum. Table 1 displays the intraoperative data. In all the cases but one, no nasal packing was placed in the operated nasal cavities.

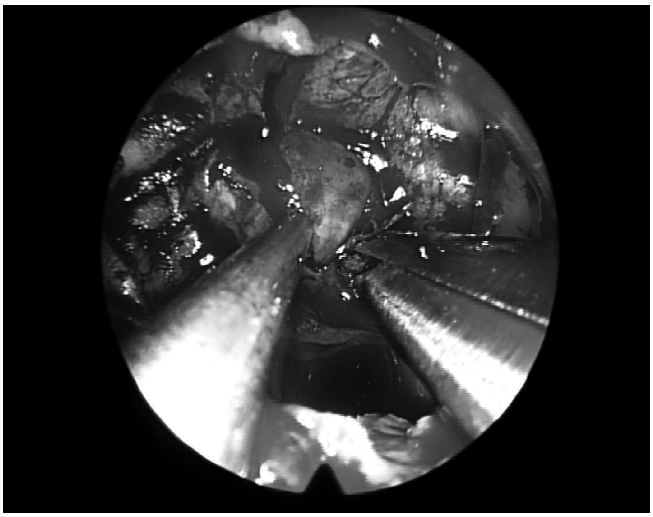

Figure 1. Intraoperative endoscopic picture – 30° telescope: resection of the floor of the sella turcica with a Kerrison forceps. (K.F : Kerrison forceps; S: suction tube).

Table 1. Technical characteristics of the surgical procedure: approach phase and resection phase.

ENT phase : approach to the sella turcica	**n=9**
Telescope	9
Operating microscope	0
Bilateral nasal approach	7
Unilateral nasal approach	2
Neurosurgical phase : tumoral resection	**n=9**
Telescope	8
Operating microscope	8
Intraoperative complication	
CSF leakage	1
Dressing into the sella	
Fibrin glue and Surgicel®	9
Recontruction of the floor of the sella	0
Dressing of the sinus operated cavity	
Fibrin glue and Surgicel®	9
Abdominal fat	1
Occlusive nasal packing	1

Table 2. Clinical description of cases with pre- and postoperative endocrine characteristics.
(LH : Luteinizing Hormone; FSH : Follicle-Stimulating Hormone; TSH : Thyroid Stimulating Hormone; ACTH : Adrenocorticotropic Hormone; GH : Growth Hormone; IGF-1 : Insulin-like Growth Factor 1).

Patient number; age(y); sex	Preoperative complaints	Preoperative diagnosis	Preoperative endocrine data	Postoperative endocrine data
1; 37; M	-Headache -Left temporal visual field reduction	-Nonfunctional macroadenoma -Pituitary apoplexy	TSH and ACTH deficiencies	TSH deficiency and recovery of normal ACTH secretion
2; 75; F	-Bitemporal hemianopsia	-Nonfunctional macroadenoma	Increased PRL level LH, FSH and IGF-1 deficiencies	Normal PRL level LH, FSH and IGF-1 deficiencies
3; 50; M	-Diplopia -Headache	-Nonfunctional macroadenoma -Pituitary apoplexy	TSH and sACTH deficiencies	Recovery of normal TSH and ACTH secretion
4 50; F	-Hyperhydrosis -Acral growth -Headache	-GH-secreting macroadenoma	Increased PRL, GH and IGF-1 levels	Normal PRL, GH and IGF-1 levels
5; 38; M	-Acral growth -Headache	-GH-secreting macroadenoma -Pituitary apoplexy.	Increased PRL, GH and IGF-1 levels	Normal PRL level GH and IGF-1 still slightly elevated
6; 36; F	-Headache	-Intrasellar and suprasellar achnoid cyst	Normal pituitary function	Normal pituitary function
7; 65; M	-Headache -Diplopia -Vomiting	-Nonfunctional macroadenoma -Pituitary apoplexy.	LH, FSH, TSH, ACTH, PRL and IGF-1 deficiencies	Persistent panhypopituitarism
8; 50; M	-Headache -Diplopia	-Adenocarcinoma metastasis	Normal pituitary function	Normal pituitary function
9; 50; M	-Hypertension -Tiredness	Cushing's disease	Increased cortisol level Testosterone deficiency	-Low cortisol level -Persistent testosterone deficiency

Postoperative cares and follow-up

From the ENT point of view, the postoperative treatment consisted of daily applications of nasal ointment and lavages with saline. Postoperative nasal endoscopy was performed 15 days, 1 month and 3 months after the surgery. A MRI was ordered three months after the surgery. Endocrinologists were following up the patients during the postoperative period by regular biological measurements.

Table 2 displays the pre- and postoperative clinical and endocrine data. Table 3 illustrates the ophthalmic and radiological findings before and after surgery (month 3). Table 4 summarizes the substitution endocrine treatment.

Patients: initial disease and demographic parameters

In this study group, 6 patients were men and 3 were women. Ages ranged from 36 to 75 years (average 50 years). Postoperative follow-up ranged from 3 to 11 months (average 6.6 months). There were 6 macroadenomas (4 nonfunctional and 2 secreting adenomas), one microadenoma (Cushing's disease), one intrasellar arachnoid cyst and one case of intrasellar biopsy for a tumor infiltrating the right cavernous sinus. One patient had previous transseptal transsphenoidal surgery (performed one year ago).

The preoperative symptoms consisted in ophthalmic signs in 5 out of the 9 cases. There were 2 cases of bitemporal hemianopsia and 3 cases of VIth cranial nerve palsy. Seven patients suffered from headache. Four of them presented with a pituitary apoplexy. There were 3 cases of secreting adenoma, 2 cases of acromegaly and 1 case of Cushing's disease. Pre- and postoperative endocrine functions were assessed upon the basis of basal hormone levels and pituitary function tests. Before surgery, TSH and ACTH deficiencies were observed in 2 patients whereas 1 patient had panhypopituitarism. Gonadotropin (LH and FSH) and insulin-like growth factor 1 (IGF-1) deficiencies were also found in 3 cases and 2 cases respectively.

RESULTS

Peroperative complications

One patient presented a CSF leakage that was successfully repaired by plugging the sella and sphenoid sinuses with fat, fibrin glue and Surgicel®. In this particular case, a nasal packing was left in place for 5 days.

Functional results

Clinical assessment

Headache disappeared rapidly during the postoperative period. All the cases of hemianopsia and diplopia but one improved significantly. This patient underwent an intrasellar biopsy for a

Table 3. Pre- and postoperative ophthalmic and imaging assessment.

Patient (number)	Preoperative ophthalmic signs	Postoperative ophthalmic signs	Preoperative MRI	Postoperative MRI	Follow-up (months)
1	Left temporal hemianopsia	Normal	Macroadenoma with right parasellar expansion and compression of the optic chiasma on the left side	Remaining parasellar nodule (2centimeters)	11
2	Bitemporal hemianopsia	Bitemporal quadranopsia	Macroadenoma with right parasellar extension	Remaining parasellar nodule (6 millimetres)	10
3	Right IIIth cranial nerve palsy	Normal	Macroadenoma with necrotic areas, suprasellar extension, compression of the optic chiasma, and right parasellar extension	No residual tissue	10
4	Normal	Normal	Macroadenoma with left parasellar extension	No residual tissue	10
5	Normal	Normal	Macroadenoma with suprasellar extension and left parasellar extension	Remaining parasellar nodule (8 millimetres)	7
6	Normal	Normal	Normal	Normal	7
7	Left VIth cranial nerve palsy	Normal	Macroadenoma with compression of the optic chiasma and left parasellar extension	No residual tissue	6
8	Right VIth cranial nerve palsy	Improvement of VIth cranial nerve palsy after radiotherapy	Expanding intrasellar process with infiltration of the right cavernous sinus	Reduction of the infiltration of the cavernous sinus	3
9	Normal oculomotor function	Normal	Microadenoma	No residual tissue	3

Table 4. Pre- and postoperative requests for hormone substitution. (H: Hydrocortisone; T4 : Levothyroxin; T : Testosterone).

Patient	Preoperative	Postoperative
1	H + T4	T4
2	None	None
3	H + T4	None
4	None	None
5	None	H
6	None	None
7	H + T4	H + T4 + T
8	None	None
9	None	None

process infiltrating the right cavernous sinus and histopathological examination showed a metastasis of an adenocarcinoma.

Endocrine monitoring

The results are shown in Table 2. In the first patient with acromegaly, GH and IGF-1 levels normalized within 3 months and MRI was normal. In the second case, the GH level remained slightly elevated, with a residual parasellar nodule. The patient with Cushing's disease was considered as cured upon the basis of low morning cortisol levels (<5μg/dl) 3 months after surgery. In patients with nonfunctional pituitary tumors (n=5), 2 of them recovered a normal corticotropic function and could discontinue hydrocortisone. One patient also recovered normal TSH secretion and could stop levothyroxin. Panhypopituitarism persisted in one patient. Gonadotropin secretion remained deficient in 3 patients as well as that of IGF-1 in 2 patients. Six patients did not require any substitution therapy.

Ophthalmic result

No postoperative blindness or vision reduction was observed in this study.

Anatomical results

Endoscopic findings

Postoperative sinonasal endoscopy at month 3 displayed a large and patent sphenoidotomy in all cases. In the first 3 patients, Surgicel® was left in place until it disappeared completely but the mucosa took at least 4 months to return to a normal state. Therefore, Surgicel® was removed 4 weeks after the surgery for the other patients. The healing course rapidly increased with a normalization of the sinus mucosa within 2 months.

No cases of synechiae or septal perforation were observed in this study.

Postoperative MRI

The arachnoid cyst and the cortisol-secreting microadenoma were resected completely. In case of macroadenoma, a parasellar residual nodule was found in 3 out of 6 cases. Two of them measured less than 1 centimetre in diameter. The other residue was of 2 centimetres in diameter and required a postoperative radiotherapy. The suprasellar extensions were completely removed and the optic chiasma was decompressed in all cases.

DISCUSSION

In this study, we demonstrated the feasibility and clinical interest of paraseptal transsphenoidal approach of the sella turcica. Furthermore, the excellent anatomical and functional results reported in this study stress the importance of combined microscopic and telescopic vision of the surgical field. For these reasons, the paraseptal endoscopic approach appears to us to be an excellent alternative to the conventional transseptal approach. However, these results must be critically discussed by comparison to the actual literature in this field.

The goals of pituitary surgery are either to perform a complete removal of the adenoma (mostly in case of secreting adenoma) or to reduce the adenoma size in order to diminish the compression of the optic chiasma, the cranial nerves and the remaining part of the normal pituitary gland [15-17]. Persistence of an asymptomatic, not secreting and not evolving nodule does not necessary mean “failure” from a functional point of view.

A wide opening of the anterior wall of the sphenoid sinuses and a large vision of the surgical field are pivotal for this type of skull basis intervention.

First of all, the access to the pituitary gland must be wide and, usually, a bilateral approach is needed. At this regard, the paraseptal approach respects the nasal anatomy and nasal septum integrity [18]. The opening towards the sphenoid sinuses is unique, median and large especially since the nasal mucosal flaps are removed. No endonasal or sublabial incision is needed. Dissection of the nasal septum can be limited to its superior and posterior part. This reduces the risks of functional and cosmetic complications often encountered with the transseptal approach such as synechiae, septal perforation, septal dislocation, nasal collapse or tip deformity [4, 8-11]. Another advantage of this approach is that no nasal packing is necessary unless complications occur (bleeding or CSF leakage). This fact is highly appreciated by the patient who can breathe through the nose from the first postoperative hours.

A large vision field is needed during surgery of the pituitary fossa. Compared to the operating microscope, the endoscopic vision by use of telescope 0° or 30° offers an incomparable vision on the bulges of the optic nerve, the carotid canal and the sella turcica. The manoeuvrability of the instruments inside the sphenoid sinus is thus facilitated and the risk of complication is reduced. In this study, only 1 patient developed a CSF leak with an initial cortisol-secreting microadenoma adherent to the diaphragma sellae. Based upon the neurosurgeon’s experience, surgery for this kind of adenoma is considered as difficult and specifically associated with a higher risk of CSF leakage, even in transseptal approach or with exclusive use of microscope [19,20]. In this particular case of CSF, the mucoperiosteum flaps would have been useful for keeping in place the fat plugged into the sphenoid sinuses during the repair procedure. But we did not have any problem or delay with the healing process without them. Considering recent literature, the incidence of neurological complications is not more frequent when surgery is performed with telescope or microscope [21-24].

The added value of a combination of paraseptal approach and use of telescope can explain the functional and anatomic results described in this study. However, during the neurosurgical phase of the procedure, the superiority of the endoscopy over the operating microscope is not yet clearly demonstrated in this study. No definitive conclusions can be drawn from this preliminary study because our short experience, the small number of patients included in this series and the systematic use of microscope at the end of the procedure by the neurosurgeon. Nevertheless, the success rate with the endoscopic technique is encouraging and higher than with the conventional microscopic surgery. In this work, with use of endoscopic vision, the resection of macroadenomas was partial in 3 out of 6 cases with persistence of a parasellar nodule. 2 of them measured less than 1 centimeter whereas the third one was 2 centimeters in diameter and required radiation therapy. On the other hand, when we consider the last 10 macroadenomas operated by our neurosurgeons with an exclusive operating microscope, 6 had persistent nodule; most of them were either suprasellar or parasellar and 3 of them needed raditation therapy. Therefore we can state that endoscopic surgery assisted with the operating microscope allows a more complete resection of the macroadenomas. The weakest area is the parasellar region, probably because this region lays close by the cavernous sinus, the internal carotid artery and the oculomotor nerves.

Lastly, endoscopic surgery has got its own learning curve. The vision and the manipulation of the instruments in endoscopic surgery are quiet different than in microscopic surgery. Therefore, during the period of transition between a purely microscopic and a purely endoscopic surgery, combination of the telescope and the operating microscope is a valid and recommended step [18].

CONCLUSION

Endonasal pituitary surgery can be performed through different ways. In the hands of an experienced surgeon, the paraseptal approach is a technique that is at least as safe and effective as the conventional transseptal approach. It gives an optimal access to the sella and maximal opening of the sphenoid ostium for the manipulation of telescopes and instruments. Complications are rare and postoperative morbidity is low. Finally, the absence of nasal packing is appreciated by the patient. Therefore, this approach merits to be considered as an interesting alternative for pituitary surgery.

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