Article

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Endoscopic endonasal transsphenoidal approach for pituitary adenomas

Technical aspects and report of casuistic

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ABSTRACT

Objective: Analyse technical aspects, effectiveness and morbidity of the endoscopic endonasal transphenoidal approach for pituitary adenomas. **Method:** From January 2005 to September 2008, 30 consecutive patients underwent endoscopic endonasal resection of pituitary adenomas with a follow up from 3 to 36 months. Their medical charts were retrospectively analysed. **Results:** There were 18 women and 12 men, mean age 44 years (range 17-65 yr). Among the 30 patients, 23 had macroadenomas and 7 microadenomas. Twelve patients had non-functioning tumors, 9 had ACTH-secreting tumors, 8 had GH-secreting tumors and 1 prolactinoma. Complete resection and hormonal control was achieved in all microadenomas. Macroadenomas were completely removed in 6 patients, subtotal resection in 6 and partial resection in 11. Three patients had diabetes insipidus and 5 had CSF leaks treated with lumbar drainage. **Conclusion:** The endonasal endoscopic approach for pituitary tumors is effective and has low morbidity.

Key words: endoscopy, pituitary, nasal, surgery.

Abordagem endoscópica endonasal para adenomas de hipófise: aspectos técnicos e relato de casuística

RESUMO

Objetivo: Analisar aspectos técnicos, eficácia e morbidade do acesso transesfenoidal endonasal endoscópico para adenomas hipofisários. **Método:** Estudo retrospectivo de trinta pacientes consecutivos submetidos à ressecção endoscópica endonasal de adenomas hipofisários, entre janeiro de 2005 e setembro de 2008, com seguimento pós-operatório entre três e 36 meses. **Resultados:** Foram operados 18 mulheres e 12 homens com idades variando entre 17 e 65 anos (média 44 anos). Entre os 30 casos operados, 23 eram macroadenomas e sete microadenomas. Doze pacientes apresentavam adenomas não-funcionantes, nove tumores secretores de ACTH, oito tumores secretores de GH e um prolactinoma. Ressecção macroscópica completa e controle endócrino foram conseguidos em todos microadenomas. Ressecção dos macroadenomas foi completa em seis pacientes, subtotal em seis e parcial em seis casos. Três pacientes desenvolveram diabetes insipidus e cinco tiveram fístula liqüórica pós-operatória controlada com drenagem lombar. **Conclusão:** A abordagem endoscópica endonasal para adenomas de hipófise é eficaz e apresenta baixa morbidade.

Palavras-chave: endoscopia, hipófise, nasal, cirurgia.

The first transnasal resection of a pituitary tumor was performed by Schloffer in 1907[1]. Cushing[2] systematically applied a transsphenoidal approach for sellar lesions. This technique was posterior refined and popularized by Guiot[3] and Hardy[4] with the introduction of the operative microscope.

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The development of endoscopic techniques for surgery of paranasal sinuses[5] awoke the possibility of an endoscopic approach for the pituitary gland. Jankowski et al.[6] described the endoscopic endonasal removal of pituitary adenomas in 3 patients. Jho and Carrau further developed the pure endonasal endoscopic surgery of pituitary tumors[7-15].

There is still controversy regarding the benefits of pituitary endoscopic surgery. We started endonasal endoscopic skull base surgery in 2005 as part of a minimally invasive concept in neurosurgery. Our results and the endoscopic technique for pituitary adenomas concerning its effectiveness and morbidity are analyzed.

METHOD

Retrospective analysis of 30 patients submitted to endoscopic endonasal removal of pituitary adenomas between January 2005 and September 2008 with a follow up from 3 to 36 months. Patients with previous pituitary surgery and lesions other than pituitary adenomas were excluded from this study.

The sample consisted of 18 women and 12 men, age range 17-65 years, median age 44 year-old.

The tumors were divided in microadenomas (<1 cm) and macroadenomas (>1 cm). The macroadenomas were further classified according to their extensions in intrasellar (S), suprasellar (SS) and invasion of cavernous sinus (CS) (Table 1).

The following parameters were evaluated preoperative and 3 months after the operation: symptoms, endocrinological assessment (measurement of cortisol, corticotrophin (ACTH), free thyroxin, thyrotropin (TSH), prolactin (PRL),growth hormone (GH), luteinizing hormone (LH), follicle-stimulating hormone (FSH), insulin-like growth factor-1, testosterone, estradiol, progesterone), neuroradiologic imaging and ophthalmologic examination in patients with clinic or radiologic evidence of chiasmal compression. Histology and immunohistochemistry of the lesions were investigated in all cases.

The degree of surgical resection was defined by the postoperative magnetic resonance imaging (MRI) as gross macroscopical resection (100%), subtotal resection (more than 80%) or partial resection (less than 80%).

Surgical procedure

Our surgical technique was based on the publications of Jho e Carrau with minor modifications[7-15].

The patients were operated on general anesthesia and orotracheal intubation, in supine position with the head fixed in a standard 3-pin-holder, slightly flexed and turned 10 degrees toward the surgeon. The video monitor was positioned behind the patient's head in front of the surgeon. The patient's face, nasal and oral cavities were prepared and draped in an aseptic manner. A gauze roll was packed into the oropharynx in order to prevent aspiration of stagnant blood at the time of extubation. ceftriaxone and clyndamicin were given 30 minutes before the surgery and kept 3 days after it. Both nostrils were washed with a topical vasoconstrictor. No intraoperative image guidance (frameless stereotatic navigation or C-arm fluoroscopy) was necessary for patients with normally pneumatized sphenoid sinus. All procedures were performed solely guided by anatomical landmarks. A 0-degree endoscope with lens diameter of 4 mm connected to a suction/irrigation device (Richard Wolf, Knittlingen, Germany) was used in all cases.

Table 1. Case distribution by tumor size and extension.

		Macroadenomas and extension			
	Microadenomas	S	S, SS	S, SS , CS	Total
Total	7	2	10	11	30

S: sellar; SS: suprasellar; CS: cavernous sinus.

A binostril approach was always performed. The surgery was divided in nasal and sellar phases.

Nasal phase: A "two-hand technique" was used. During this step the surgeon held the endoscope with his left hand and an instrument with his right hand. The middle turbinate was lateralized and the sphenoid ostia located bilaterally. A wide sphenoidotomy followed by removal of inter and intrasinusal septa and exposure of clivus, sellar floor, carotid prominences, opticocarotid recesses and planum sphenoidale were done (Fig 1).

Sellar phase: A "three-hand" technique was used. An assistant held the endoscope in order to give the surgeon the possibility of working with 2 instruments and perform a bimanual dissection. The sellar floor was removed using a high-speed drill. The dura mater was opened and sellar content exposed (Fig 2).

All attempts were made to preserve normal pituitary tissue. The sellar tumor was removed with standard neurosurgical technique. The endoscope was then introduced inside the sella in patients with macroadenomas and a careful search for tumor remnants was made. In the case of macroadenomas with supraselar extensions the endoscope was further directed to the suprasellar region and the tumor removed (Fig 3).

In case of significant perioperative cerebrospinal fluid (CSF) leak, a multilayer sellar reconstruction was made using fat graft, fascia lata, Gel foam (Upjohn, Kalamazoo) and fibrin glue. When no perioperative CSF leak was seem only Gel foam and fibrin glue were used to close the sella.

All procedures were performed with informed consent of the patients.

This study was approved by the Research Ethics Com-

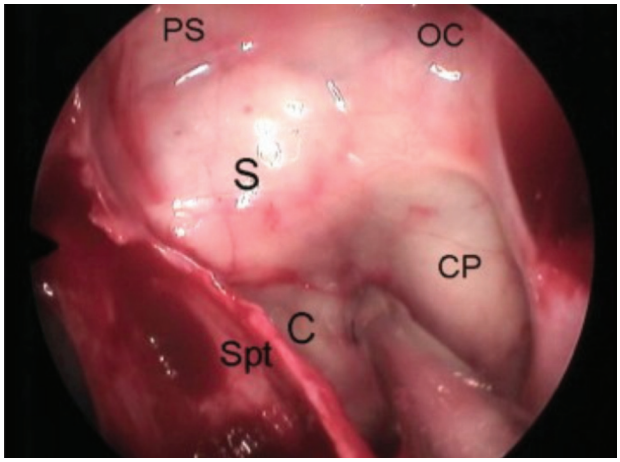

Fig 1. Endoscopic view of the sphenoidal sinus with the right side partially covered by an intrasinusal septum [Spt]. [C] clivus, [S] sellar floor, [PS] planum sphenoidale, [CP] carotid prominence, [OC] opticocarotid recess.

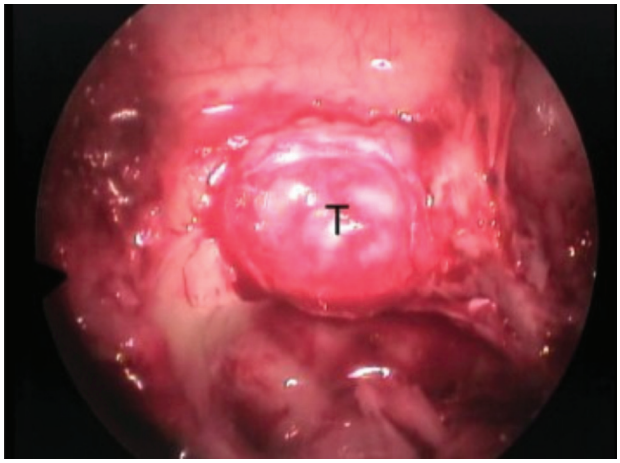

Fig 2. Endoscopic view of the sellar content in a patient with macroadenoma after opening the dura mater. [T] tumor.

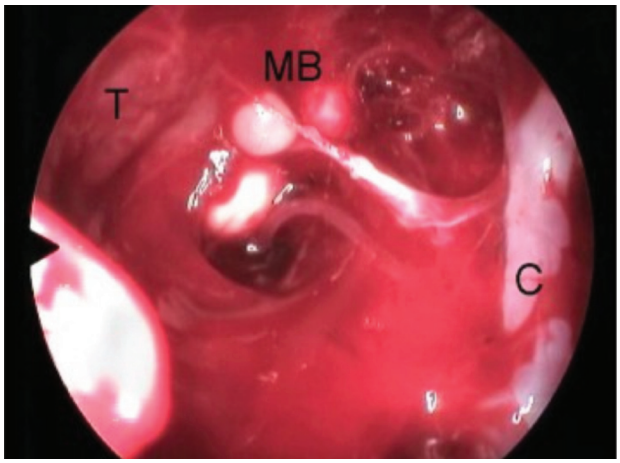

Fig 3. Endoscopic view of the supraselar region in a patient with macroadenoma with supraselar extension. [MB] mamillary bodies, [C] carotid artery, [T] tumor.

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RESULTS

There were 12 (40%) non-functioning pituitary adenomas, 9 (30%) ACTH-secreting adenomas, 8 (26%) GH-secreting adenomas and one (3%) prolactinoma confirmed with histology and immunohistochemistry.

Non-functioning adenomas

There were 6 macroadenomas with sellar and suprasellar extensions. Another 6 macroadenomas had additionally cavernous sinus invasion. The tumor was totally removed in 3 cases, sub totally (more than 80 %) in 3 cases and partially (less than 80 %) in 6 cases.

The immunohistochemistry of the lesions revealed 6 null cell tumors and 6 LH and FSH secreting-adenomas.

ACTH-secreting adenomas

There were 9 patients with confirmed Cushing's disease based on clinical endocrinological and immunohistochemical evaluation, 5 macroadenomas and 4 microadenomas. Complete tumor resection and biochemical control of the disease (defined as postoperative plasmatic cortisol levels lower than 7 mg/dl) were achieved in all microadenomas and in one case of macroadenoma restricted to the sella. Two patients with sellar and supraselar lesions had subtotal and partial resection of their lesions and should be submitted to reoperation. Two patients had lesions with extensions to the cavernous sinus and their tumors were partially removed. One of then was submitted to a supraorbital craniotomy and complete removal of the lesion followed by hormonal control. The other one was referred to radiosurgery but remains with high cortisol levels.

GH-secreting adenomas

There were 8 acromegalic patients with confirmed GH-secreting adenomas. Hormonal control was defined as GH <1.0 ng/ml and not higher than 0.4 ng/ml after glucose load and IGF-1 levels normal for age.

Gross macroscopical tumor removal and hormonal control was obtained in 3 cases of microadenomas, in 1 case of macroadenoma restricted to the sella and in 1 case of sellar and supraselar macroadenoma. No additional therapy was necessary for these patients.

One sellar/supraselar macroadenoma and two cases with cavernous sinus invasion were sub totally removed and therapy with Octreotide was started. The patient with a remnant tumor sellar/supraselar was reoperated and gross macroscopical removal was achieved.

One case of cavernous sinus invasion was submitted to radiosurgery due to lack of control with octreotide.

Table 2. Tumor extension and removal.

Extension	No patients	Tumor removal		
		Total	Subtotal	Partial
Microadenoma Macroadenoma	7	100% (7)	–	–
S	2	100% (2)	–	–
S, SS	10	30% (3)	40% (4)	30% (3)
S, SS e SC	11	9% (1)	18% (2)	73% (8)
Total	30	43% (13)	20% (6)	37% (11)

S: sellar; SS: suprasellar; CS: cavernous sinus.

Table 3. Visual improvement and tumor extension.

Extension	Visual disturbance	
	Preoperative	Postoperative Improvement
Microadenoma	–	–
S	2	2
S, SS	8	5
S, SS e SC	11	4
Total	70% (21/30)	47% (10/21)

S: sellar; SS: suprasellar; CS: cavernous sinus.

Prolactin-secreting adenomas

One patient had a giant prolactinoma that caused sudden visual deterioration and oculomotor nerve palsy. This tumor was partially removed and carbegoline therapy started. Prolactin levels were normalized and the neurological deficits improved.

Table 2 summarizes the overall amount of tumor removal compared with tumor size and extension.

Table 3 summarizes pre and post operative visual disturbances compared with tumor size extension.

Complications

Five patients developed postoperative cerebrospinal fluid (CSF) leaks treated successfully with 3 days of lumbar drainage. None of the patients developed meningitis. One patient had communicating hydrocephalus and required a ventriculo-peritoneal shunt. Three patients had diabetes insipidus, two of them permanent. There was no postoperative nasal bleeding or other significant nasal disturbances.

There were no neurological disturbances or casualties related to the operations in this series.

DISCUSSION

Any new surgical technique must show benefits that overcome the previous surgical options and more important than that; it must be safe.

The widespread use of endoscopes in all surgical disciplines has reached neurosurgical procedures in a delayed way. A great step related with the development of endoscopic neurosurgery was the team work with otorhinolaryngologists in skull base approaches. The previous otorhinolaryngologic experience with endoscopic surgery for paranasal sinuses[5] was the milestone for development of endoscopic endonasal pituitary surgery.

The endoscopic approach has obvious advantages when compared with the traditional sublabial transseptal microscopic surgery. It avoids sublabial incision, dissection of septal mucosa and fracture of nasal septum reducing postoperative morbidity[16]. There is no need of nasal speculum which narrows the surgical corridor limiting visualization and manipulation of instruments. The endoscopes offer a wide angle of view that provides better visualization of anatomical landmarks. Based on anatomical landmarks it is possible to avoid intraoperative fluoroscopy, commonly used in traditional surgery, preventing patients and surgical team to unnecessary exposure to radiation.

Another advantage of endoscopic surgery is the possibility of introduction of the endoscope inside the sella turcica and the supraselar region for the search of tumor remnants not accessible with microsurgery.

There is still controversy regarding the superiority of endoscopic pituitary surgery compared with transphenoidal microsurgery[17-19] but the benefits of endoscopy should no longer be questioned.

The literature of pituitary surgery has significant different rates of tumor removal that reflects distinct surgical techniques and stages of learning curve[11,16-22]. Our results reflect our learning process and the preponderance of patients with advanced disease. Tumors with sellar/supraselar and cavernous sinus extensions were the most common in our series (36%) and gross macroscopical resection was achieved in only 1 case (9%). In the other hand, it was possible to completely remove all functioning microadenomas (23%) resulting in a better endocrinological outcome for those patients. Our rate of visu-

al improvement after surgery (47%), based on visual field campimetry, is comparable to other series[18-22].

Complications common to microscopic or endoscopic transsphenoidal approach include CSF leaks and meningitis[19,23-25]. Five of our patients had CSF leaks but no one developed meningitis. This is probably due to lack of routine reconstruction of sella turcica. We only reconstructed the sella when perioperative CSF leak was visualized. Additionally, the free fat grafts that are normally used may not be the best material to prevent the leaks. Recently the use of nasal vascularized flaps has proved superiority to prevent CSF leaks[26]; therefore we believe that reconstruction of sella turcica using this technique is advisable.

Based in the results of our series and the reports of literature we found that the endoscopic endonasal approach for pituitary adenomas is effective and has low morbidity.

REFERENCES

1. Landolt AM. History of transsphenoidal pituitary surgery. In Landolt AM, Vance ML, Reilly PL (Eds). Pituitary adenomas. London: Churchill Livingstone 1996:307-314.
2. Rosegay H. Cushing's legacy to transsphenoidal surgery. J Neurosurg 1981;54: 448-454.
3. Guiot A. Transsphenoidal approach in surgical treatment of pituitary adenomas: general principles and indications in nonfunctioning adenomas. In: Kohler PO, Ross GT (Eds). Diagnosis and treatment of pituitary tumors. Amsterdam: Excerpta Medica, International Congress Series No 303, 1973:159-178.
4. Hardy J. Transphenoidal microsurgery of the normal and pathological pituitary. Clin Neurosurg 1969;16:185-217.
5. Stammberger H. Endoscopic endonasal surgery: concepts in treatment of recurring rhinosinusitis. Part II. Surgical technique. Otolaryngol Head Neck Surg 1986;94:147-156.
6. Jankowski R, Auque J, Simon C, Marchal JC, Hepner H, Wayoff M. Endoscopic pituitary tumor surgery. Laryngoscope 1992;102:198-202.
7. Carrau RL, Jho HD, Ko Y. Transnasal-transsphenoidal endoscopic surgery of the pituitary gland. Laryngoscope 1996;106:914-918.
8. Jho HD. Endoscopic endonasal pituitary surgery: technical aspects. Contemporary Neurosurgery 1997;19:1-7.
9. Jho HD, Carrau RL, Ko Y. Endoscopic pituitary surgery. In: Wilkins RH, Rengachary SS (Eds). Neurosurgical operative atlas. Baltimore: Williams&Wilkins 1996;5:1-12.
10. Jho HD, Carrau RL. Endoscopic assisted transsphenoidal surgery for pituitary adenoma. Technical note. Acta Neurochir (Wien) 1996;138:1416-1425.
11. Jho HD, Carrau RL. Endoscopic endonasal transsphenoidal surgery: experience with 50 patients. J Neurosurg 1997;87:44-51.
12. Jho HD, Carrau RL, Ko Y, Daly M. Endoscopic pituitary surgery: an early experience. Surg Neurol 1997;47:213-223.
13. Jho HD.Endoscopic pituitary surgery. Pituitary 1999;2:139-154.
14. Jho HD, Alfieri A. Endoscopic endonasal pituitary surgery: evolution of surgical technique and equipment in 150 operations. Minim Invasive Neurosurg 2001;44:1-12.
15. Jho HD, Alfieri A. Endoscopic transsphenoidal pituitary surgery: various surgical techniques and recommended steps for procedural transition. Br J Neurosurg 2000;14:432-440.
16. Santos Rde P, Zymberg ST, Abucham Filho JZ, Gregório LC, Weckx LL. Endoscopic transnasal approach to sellar tumors. Braz J Otorhinolaryngol 2007;73:463-475.
17. Sheehan MT, Atkinson JL, Kasperbauer JL, Erickson BJ, Nippoldt TB. Preliminary comparison of the endoscopic transnasal vs. the sublabial transseptal approach for clinically nonfunctioning pituitary macroadenomas. Mayo Clin Proc 1999;74:661-670.
18. Frank G, Pasquini E, Farneti G, et al. The endoscopic versus the traditional approach in pituitary surgery. Neuroendocrinology 2006;83:240-248.
19. Dehdashti AR, Ganna A, Karabatsou K, Gentili F. Pure endoscopic endonasal approach for pituitary adenomas: early surgical results in 200 patients and comparison with previous microsurgical series. Neurosurgery 2008;62:1006-1017.
20. Cappabianca P, Cavallo LM, Colao A, et al. Endoscopic endonasal transsphenoidal approach: outcome analysis of 100 consecutive procedures. Minim Invasive Neurosurg 2002;45:193-200.
21. Ferrante L, Trillò G, Ramundo E, et al. Surgical treatment of pituitary tumors in the elderly: clinical outcome and long-term follow-up. J Neurooncol 2002;60:185-191.
22. Mortini P, Losa M, Barzaghi R, Boari N, Giovanelli M. Results of transsphenoidal surgery in a large series of patients with pituitary adenoma. Neurosurgery 2005;56:1222-1233.
23. Cappabianca P, Cavallo LM, Colao A, de Divitiis E. Surgical complications associated with the endoscopic endonasal transsphenoidal approach for pituitary adenomas. J Neurosurg 2002;97:293-298.
24. Black PM, Zervas NT, Candia GL. Incidence and management of complications of transsphenoidal operation for pituitary adenomas. Neurosurgery 1987;20:920-924.
25. Ciric I, Ragin A, Baumgartner C, Pierce D. Complications of transsphenoidal surgery: results of a national survey, review of the literature, and personal experience. Neurosurgery 1997;40:225-237.
26. Hadad G, Bassagasteguy L, Carrau RL, et al. A novel reconstructive technique after endoscopic expanded endonasal approaches: vascular pedicle nasoseptal flap. Laryngoscope 2006;116:1882-1886.