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 transsphenoidal 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

The first transnasal resection of a pituitary tumor was performed by Schloffer in 1907. Cushing systematically applied a transsphenoidal approach for sellar lesions. This technique was posterior refined and popularized by Guiot and Hardy with the introduction of the operative microscope.
The development of endoscopic techniques for surgery of paranasal sinuses awoken the possibility of an endoscopic approach for the pituitary gland. Jankowski et al. described the endoscopic endonasal removal of pituitary adenomas in 3 patients. Jho and Carrau further developed the pure endonasal endoscopic surgery of pituitary tumors.

There is still controversy regarding the benefits of pituitary endoscopic surgery. We started endonasal endoscopic skull base surgery in 2005 as a 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 preoperatively 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. 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 sinuses. 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.

A binasal 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 suprasellar 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 seen 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-
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 suprasellar 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 them 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 suprasellar macroadenoma. No additional therapy was necessary for these patients.

One sellar/suprasellar 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/suprasellar 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.
Pituitary adenomas: endoscopic endonasal transsphenoidal approach

Santos et al.

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 was the milestone for development of endoscopic endonasal pituitary surgery.

The endoscopic approach has obvious advantages when compared with the traditional sublabial transsphenoidal microscopic surgery. It avoids sublabial incision, dissection of septal mucosa and fracture of nasal septum reducing postoperative morbidity. 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 suprasellar region for the search of tumor remnants not accessible with microsurgery.

There is still controversy regarding the superiority of endoscopic pituitary surgery compared with transsphenoidal microsurgery 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. Our results reflect our learning process and the preponderance of patients with advanced disease. Tumors with sellar/suprasellar 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 vis-
al improvement after surgery (47%), based on visual field campimetry, is comparable to other series.

Complications common to microscopic or endoscopic transsphenoidal approach include CSF leaks and meningitis. 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; 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 adenoma is effective and has low morbidity.

REFERENCES