Internal carotid pseudoaneurysm after transsphenoidal resection of a pituitary adenoma: an endovascular approach model

Bruno C. R. Lázaro*
Marlo S. Flores*
Orlando M. Júnior*
José A. Landeiro**

* Department of Neurosurgery Brazilian Air Force Hospital
** Head of Department of Neurosurgery

Abstract
We present a case of pseudoaneurysm formation after endonasal endoscopic transsphenoidal resection of a pituitary adenoma, with an endovascular treatment proposal: as the patient failed in balloon catheter occlusion test of the internal carotid artery, an alternative model of treatment was proposed, consisting of using detachable coils and placing a stent in the internal carotid artery adjacent to the vascular formation. After a dramatic initial presentation of a massive epistaxis, the patient had a significant improvement after treatment.

Key words
Pituitary surgery, pseudoaneurysm, endovascular treatment.

Sinopse
Pseudoaneurisma da artéria carótida interna após ressecção transesfenoidal de macroadenoma hipofisário. Uma proposta de tratamento endovascular: como o paciente tornou-se sintomático no teste de oclusão da artéria carótida interna, um modelo alternativo - endovascular - foi proposto, consistindo no uso de molas e de um Stent vascular colocado adjacente à luz do pseudoaneurisma. Após uma grave manifestação clínica, consistindo em hemorragia nasal maciça, o paciente evoluiu satisfatoriamente após o tratamento.

Palavras-chave
Cirurgia transesfenoidal, pseudoaneurisma, tratamento endovascular.

Introduction
Transsphenoidal resections of pituitary tumors are widely described in clinical trials, and represent an excellent surgical approach to pituitary adenomas treatment. Ultimately, the endonasal endoscopic approach has proved to be an excellent alternative to the management of pituitary adenomas. Some complications can be expected from this type of surgery: one of the most feared complications on postoperative assessment is the pseudoaneurysm formation, generally involving the intracavernous internal carotid artery. The clinical findings are generally dramatic, presenting with a massive hemorrhage consisting of epistaxis, with catastrophic proportions when not suspected in due course or if incorrectly treated.
Case report

A 44-year-old Caucasian male presented with a two-month-episode of visual disturbance described as a “black field” on the temporal side of the left eye. He was brought to our hospital for neurological evaluation. The patient had no other complaints and the neurological examination showed only a left visual field temporal hemianopsia. Visual fields evaluation confirmed the clinical findings. MRI revealed a lobulated sellar mass, isointense in T1 and T2, with enhancement after gadolinium infusion, with a supra-sellar and left para-sellar extension, causing superior shift of the optic chiasm, and invading the left cavernous sinus (Figure 1). As hormonal testing revealed normal values, a nonfunctioning pituitary adenoma was diagnosed.

Surgical procedure was performed, with a transsphenoidal approach guided by endoscopy, with a bilateral sphenoidal sinusotomy, turbinectomy and septoplasty, with total resection of the tumor. Histopathologic analysis confirmed the diagnosis, and postoperative visual fields were normal. Two weeks later, the patient returned for a postoperative evaluation: a massive hemorrhage occurred after manipulation of the dressings. The patient returned to the operating room for a revision of the hemostasis: massive hemorrhage coming from the sphenoid bone, was hardly controlled with thermocoagulation, bone wax, surgicel, fat and fibrin glue associated with an anterior and posterior nasal and sphenoidal sinus packing. The patient was transferred to the Intensive Care Unit (ICU) presenting with severe hypotension, hypovolemic shock, and acute respiratory failure. Neurological assessment after clinical stabilization demonstrated a left hemiparesis. A brain CT scan was performed, revealing a right parietal hypodense area, associated with a suprasellar lesion (Figure 2). Digital angiography revealed a intracavernous right internal carotid artery (ICA) pseudoaneurysm, measuring 1cm, adjacent to the origin of the ophthalmic artery (Figure 3). A balloon occlusion test of the internal carotid artery was performed but the patient failed the test. An alternative model of approach was then proposed: an endovascular access was performed after bilateral catheterization of the femoral arteries; after visualization of the pseudoaneurysm, a stent was positioned in the ICA, next to the vascular malformation, in association with electro-detachable coils placed within the pseudoaneurysm: a gross total filling of the lumen was accomplished, with a good clinical postoperative result (Figure 4). The patient was maintained in the ICU until stabilization, showing a satisfactory clinical and

FIGURE 1.
Coronal MRI, T1-weighted image with gadolinium enhancement showing a sellar and suprasellar lobulated mass.

FIGURE 2.
Brain CT Scan reveals a left hypodense area corresponding to an infarct of the parietal lobe.
neurological improvement, including partial regression of the left hemiparesis, and progressive improvement of the level of conscience. He was discharged from the ICU conscious, with minimal left hemiparesis.

Six months later, an angiogram revealed a severe stenosis of the lumen of the carotid artery (Figure 5), probably caused by endothelial injury after endovascular catheterization. Injection of vertebral artery showed retrograde filling of the anterior circulation (Figure 6). The patient still had a minimal degree of left hemiparesis, presenting progressive improvement with physiotherapy. Endovascular internal carotid obliteration would be the treatment of choice, but considering the good neurological situation of the patient, our decision consisted only in observation.

Discussion

Transsphenoidal approach to pituitary adenomas is used in large-scale worldwide. It had been resurrected and put into large clinical practice due to the efforts of surgeons like Norman Dott of Edinburgh, Gerard Guiot of Paris and Jules Hardy, after the historical contribution of Harvey Cushing. After the contribution of Jules Hardy, who introduced the use of a microscope for this procedure, there were no great changes in the way of approaching the lesion, until the introduction of the endoscope in pituitary surgery in practical use in the mid 1990s.
Although the transsphenoidal approach is considered to be the gold-standard route to pituitary adenomas, a series of complications had been described. The most common complications are anterior pituitary insufficiency and diabetes insipidus, followed by septum perforation and cerebrospinal fluid leak. A wide range of supra and parasellar complications due to the endoscopic procedure is practically the same when compared with the traditional approach. Internal carotid artery (ICA) injury is an uncommon complication, but it represents an important factor concerning morbidity and mortality. The percentage of transsphenoidal operations resulting in carotid artery injuries varies according to the surgeon’s experience from 0.4% (in the most experienced group) to 1.4% (in the least experienced one), according to a study performed with 958 neurosurgeons in the United States. A number of vascular complications related to ICA injury (such as carotid laceration, carotid-cavernous fistula, subarachnoid hemorrhage and pseudoaneurysm formation) are reported in a series of procedures, with transsphenoidal route (pituitary ablation, adenoma removal, repair of cerebrospinal fluid leaks), and others, like paranasal sinus operation and thromboendoarterectomy.

Development of a pseudoaneurysm after transsphenoidal surgery is a very uncommon feature. Only a few cases had been reported in the literature. In a study with 250 patients with pituitary adenomas, only one case (0.4%) of pseudoaneurysm had occurred. ICA injury typically occurs during aggressive dissection of macroadenomas that extend into the cavernous sinus and encase the carotid artery.

Some risk factors have been described in pseudoaneurysm formation, like previous transsphenoidal surgery, cavernous sinus invasion by the tumor, adhesion of the tumor to the carotid artery, small sella, previous treatment with bromocriptine and radiation therapy, lateral deviation from the midline during surgery. Symptoms rapidly occur, initially causing signs of cavernous sinus involvement, later producing epistaxis due to rupture into the paranasal sinus. The resultant hemorrhage happens hours or days later, most commonly between 8 and 15 days, but a more delayed appearance (months to 10 years) has been reported. The most common symptom associated with pseudoaneurysm formation is epistaxis; other symptoms related are subarachnoid hemorrhage and intracerebral clot, with a combined morbidity and mortality rate, similar to the rupture of a saccular aneurysm. Furthermore, patients harboring a pseudoaneurysm may be at risk for stroke caused by thromboemboli originating in the injured artery or within the structure of the pseudoaneurysm. Massive hemorrhage may happen. Our patient presented with severe bleeding and hypovolemic shock, only controlled with nasal packing, hemotransfusion and ICU support.

Renn and Rhoton demonstrated that the carotid artery bulges into the sphenoid sinus in 71% of cases and that the arteries are covered only by the dura mater of the cavernous sinus and the mucosa of the sphenoid sinus in 4% of cases. In addition, carotid arteries are found as close as to 4mm to the midline within the sella (mean distance up to 12mm). Adequate bleeding control is achieved with anterior and posterior nasal packing, as described in our report. Anterior nasal packing alone is inadequate; posterior packing provides compression of the posterior middle turbinate, which in turn compresses the sphenopalatine and internal maxillary arteries. When nasal hemorrhage after transsphenoidal surgery occurs, angiographic study becomes imperative, with selected images of both internal and external carotid circulation. Extravasation of contrast material or opacification of a pouch of any shape are labeled as pseudoaneurysm, which usually fills later in the arterial phase, has less opacity and slower emptying than berry aneurysms.

Some treatment alternatives had been described: usually a direct surgical approach to the pseudoaneurysm is ineffective. It is an invasive method, adding morbidity to the process and, given the fragility of the structure, bleeding is generally inevitable. With the development of the endovascular approach, complete occlusion of the internal carotid was used in a large scale, usually performed after carotid occlusion test. Placement of detachable balloons in the parent artery above and below the pseudoaneurysm will completely eliminate the blood flow. If carotid occlusion is indicated, the endovascular approach offers two major advantages over surgical ligation: it can be performed with the patient awake, with monitoring of the neurologic status, and ICA occlusion is achieved, with minimal thromboembolic complications. With the development of new techniques, materials and larger experience with the endovascular method, the use of a direct approach to the
pseudoaneurysm can be accomplished. An alternative approach, for patients who fail the carotid occlusion test can be performed: complete obliteration of the lesion with preservation of the ICA can be obtained with the use of detachable coils occlusion adjuvant to the positioning of a stent placed across the pseudoaneurysm segment, as performed in our case. The placement of a stent provides other advantages, such as stabilization of possible artery dissection; it also contributes to the preservation of the patency of the ICA, changes flow dynamics within the trombosis-promoting structure, assists in coil packing and decreases the risk of coil dislodgement.

Endovascular treatment represents a valuable option with several benefits over the direct surgical approach, exemplified as an easier performance method, associated with lower morbidity and mortality rate; although the endovascular treatment of choice is carotid occlusion, there are patients who do not tolerate the occlusion test. In these cases, the use of an alternative approach can be applied, with the use of detachable coils and stenting of the parent vessel, which permits a complete exclusion of the pseudoaneurysm, with preservation of the artery.

Conclusion

Pseudoaneurysm formation is a rare but potentially fatal complication after transsphenoidal resection of pituitary adenomas. Postoperative epistaxis implicates in mandatory angiography. Various methods and approaches are reported as options for the treatment of false aneurysm of the ICA, such as direct surgical and endovascular approach.

This article shows the role of endovascular approach for this lesion, with emphasis on an alternative model of treatment, in patients who fail the internal carotid occlusion test, consisting on the use of detachable coils inside the lumen of the false aneurysm, with adjuvant placement of a stent on the neck of the pseudoaneurysm.

References


Corresponding Author

José Alberto Landeiro, MD, PhD
Brazilian Air Force Hospital
Estrada do Galeão 4101
Rio de Janeiro, RJ, 21941-000, Brazil.
Phone-fax: 55-21-24925418
E-mail: jlandeiro@aol.com