



# Pituitary Macroadenoma Coexistent with a Posterior Circulation Aneurysm Leading to Subarachnoidal Hemorrhage During Transsphenoidal Surgery

## *Transsfenoidal Cerrahi Sırasında Subaraknoid Kanamaya Neden Olan Posterior Dolaşım Anevrizması ile Pitüiter Makroadenom Birlikteliği*

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### ABSTRACT

The coexistence of cerebral aneurysm and pituitary adenoma has been described previously. Most of such cases harbor functional tumors and anterior circulation aneurysms, with very rare cases of posterior circulation aneurysms.

In this report, we present a case of subarachnoidal hemorrhage due to rupture of an undetected basilar apex aneurysm during microscopic transsphenoidal surgery for a nonfunctional pituitary adenoma. Subarachnoidal hemorrhage following transsphenoidal surgery is a rare event. The concurrence of posterior circulation aneurysm and nonfunctional adenoma is uncommon too.

Neuroimaging of cerebrovascular circulation before surgical treatment of pituitary adenoma, although controversial, would be helpful to evaluate vascular involvement and rule out any potential concurrent cerebrovascular diseases. Open or endovascular treatment of unruptured intracranial aneurysms carries relatively low morbidity and may be considered prior to other elective intracranial procedures like transsphenoidal surgery.

**KEYWORDS:** Intracerebral aneurysm, Pituitary adenoma, Subarachnoidal hemorrhage, Transsphenoidal surgery

### ÖZ

Daha önce serebral anevrizma ve pitüiter adenomun birlikte bulunması bildirilmiştir. Bu olguların çoğunda fonksiyonel tümörler ve anterior dolaşım anevrizmaları bulunurken nadiren posterior dolaşım anevrizmaları görülür.

Bu raporda, fonksiyonel olmayan bir hipofiz adenomu için mikroskopik transsfenoidal cerrahi sırasında, önceden saptanmamış olan bir baziller apeks anevrizmasının rüptürü nedeniyle subaraknoid kanama olgusu sunuyoruz. Transsfenoidal cerrahi sonrasında subaraknoid kanama nadir bir olaydır. Posterior dolaşım anevrizması ve fonksiyonel olmayan adenomun birlikte bulunması da nadirdir.

Hipofiz adenomunun cerrahi tedavisi öncesinde serebrovasküler dolaşım için nörogörüntüleme tartışmalı olsa da vasküler tutulumu değerlendirmek ve varsa eş zamanlı serebrovasküler hastalıkları ekarte etmek açısından faydalı olacaktır. Rüptüre olmamış intrakraniyal anevrizmaların açık veya endovasküler tedavisi nispeten düşük morbiditeye sahiptir ve transsfenoidal cerrahi gibi elektif intrakraniyal işlemler öncesinde düşünülebilir.

**ANAHTAR SÖZCÜKLER:** İntraserebral anevrizma, Pitüiter adenom, Subaraknoid kanama, Transsfenoidal cerrahi

### INTRODUCTION

The concurrence of anterior circulation aneurysm and a pituitary adenoma is not an unusual condition. The higher prevalence of cerebral aneurysm in patients with growth hormone (GH)-secreting adenoma has been confirmed previously (14, 20). Most reported cases of such concurrence harbor *anterior* circulation aneurysms (1, 2, 5, 6, 8, 9, 16, 11, 23-25, 27-29, 31-36). However, simultaneous *posterior* circulation aneurysms and pituitary adenomas seem to be less common (15). Coexisting basilar tip aneurysm and nonfunctional pituitary adenoma has not been reported in the published literature.

In this report, we present a case of spontaneous perioperative subarachnoidal hemorrhage (SAH) owing to rupture of

an undetected basilar apex aneurysm following a transsphenoidal surgery (TSS) for a nonfunctional pituitary adenoma. The exceptional point in this case is the multiple associations between a *nonfunctional* macroadenoma, a *posterior* circulation aneurysm, a perioperative rupture, and an early severe vasospasm.

### CASE REPORT

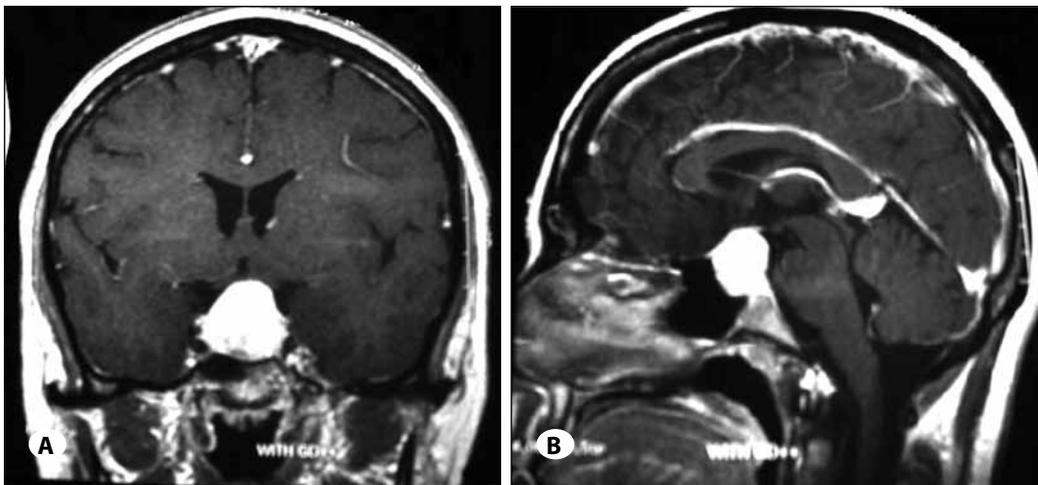
A 35-year-old female underwent elective transsphenoidal surgery for a nonfunctional pituitary macroadenoma 2×2×2.5 cm in size (Figure 1A, B). Preoperative neurological evaluation was intact except for bitemporal hemianopia, more severe on the right side. A microscopic endonasal submucosal approach was used in the supine position under general anesthesia (by isofluran, fentanyl, and propofol), with the head being held

in a horseshoe headrest. Near total resection accomplished with no intraoperative problems such as arachnoid tearing or massive hemorrhage. During the procedure, surgical instruments never went beyond the tumor boundaries and cerebrospinal fluid (CSF) never entered the field even after a Valsalva maneuver. No additional intraoperative maneuvers such as bilateral jugular vein compression, alternative positive end expiratory pressure, or instillation of air or lactated Ringer's solution into the lumbar subarachnoid space were used for tumor delivery. The whole anesthesia took around 2 hours, and no rises in the heart rate or blood pressure were detected during the procedure. However, the patient emerged from anesthesia with right hemiparesis, left side 3rd nerve palsy, and impaired consciousness with a postoperative GCS score of 8 (eye opening with painful stimuli, moaning, and motor withdrawal response). Immediate postoperative computed tomography (CT) revealed a massive bilateral subarachnoidal hemorrhage without evidence of intraparenchymal hematoma, tissue infarction, or edema (Figure 2A, B). Computed tomography angiogram demonstrated a small saccular aneurysm at the tip of basilar

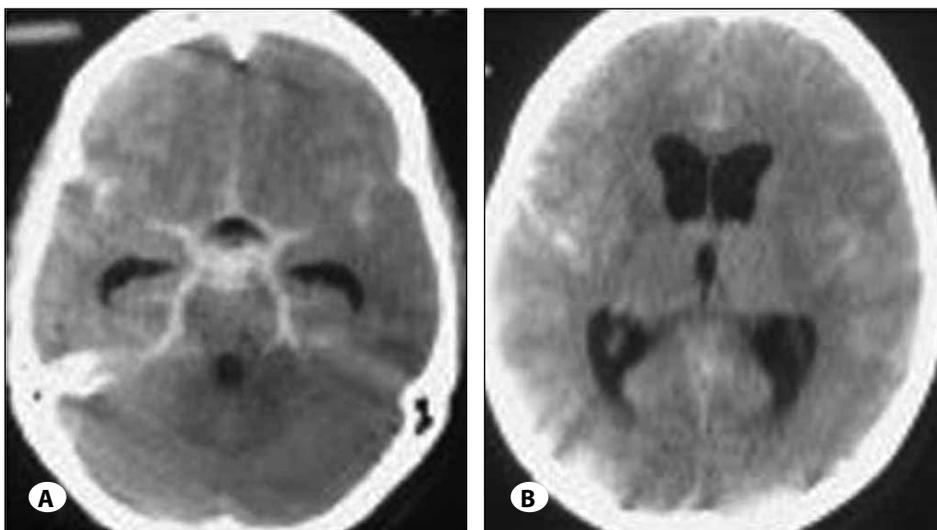
artery. The left superior cerebellar artery (SCA) was not filled due to severe vasospasm (Figure 3A-C). Soon after, the patient developed hydrocephalus that was managed with external ventricular drainage. The consciousness and motor functions did not improve despite the comprehensive care. The fourth day brain CT showed infarction in the superior surface of the left cerebellar hemisphere and the cerebral peduncles, accompanied by massive brain edema. The patient developed pneumonia and acute renal failure necessitating hemodialysis on the 7<sup>th</sup> and 10<sup>th</sup> postoperative days respectively, and died from severe acidosis and hyperkalemia on the 13<sup>th</sup> day.

### DISCUSSION

Transsphenoidal surgery is an established surgical procedure for the resection of pituitary lesions. The procedure is considered to be safe (4), with an overall mortality and major morbidity rate of less than 0.5% and 1.5% respectively, based on the results of the University of Virginia Cohort between 1972 and 2004 (12). Even so, potentially life-threatening complications may infrequently occur after TSS. Postoperative rhinorrhea and neurological deficits have been reported



**Figure 1:** T1-weighted **A)** coronal and **B)** midsagittal magnetic resonance images reveal an enhancing pituitary adenoma.



**Figure 2A, B:** Postoperative computed tomography (CT) showing a massive bilateral subarachnoidal hemorrhage.

as the most common complications in different series (17, 22). Tension pneumocephalus (26), intracavernous carotid artery pseudoaneurysm formation (4), and subarachnoidal hemorrhage (13) have also been reported.

#### **Coexisting Cerebral Aneurysms and Pituitary Adenomas**

The coexistence of cerebral aneurysm and pituitary adenoma has been described and may be particularly frequent in acromegaly (34). An age-matched comparison of the prevalence of cerebral aneurysm showed a significant increase

in patients with adenoma compared with the controls (18). Most such cases harbor an *anterior* circulation aneurysm (1, 2, 5, 6, 8, 9, 16, 11, 23-25, 27-29, 31-36). The incidence of anterior circulation aneurysms in pituitary adenomas is approximately 2.3%-3.6% and the earliest reports date back to 1959 (2, 18, 21). In the acromegaly group the incidence is even higher, with the rate of 4.3 % (20). According to previous observations, an intracranial aneurysm that co-exists with a sellar lesion is more frequently observed in the internal carotid artery (ICA) and anterior communicating artery because they supply the pituitary region (32). Even so, the concurrence of pituitary adenoma and posterior circulation aneurysms is much less common. A single case of pituitary adenoma associated with a giant aneurysm of vertebrobasilar junction has been described previously and was considered to be an independent coincidence in postmortem studies (15). In the largest MR angiography-based survey to verify the increased rate of intracranial aneurysms in acromegaly, no aneurysms belonged to the vertebrobasilar circulation were found (14). The presented case harbored a basilar apex aneurysm that was not previously reported in cases of coexisting adenomas and intracerebral aneurysms.

Some cases of incidental revealing of intracranial aneurysms associated with pituitary adenomas published in the English literature in the last three decades are summarized in Table I. We excluded the cases of coinciding pituitary adenoma and non-aneurysmal SAH, or simultaneous aneurysm and ischemic apoplexy of pituitary gland due to aberrant blood supply. Intracavernous ICA aneurysm can be misdiagnosed as a macroadenoma and even present with pituitary apoplexy (7, 29, 30), while pituitary apoplexy presenting with intracerebral hemorrhage may simulate an anterior circulation aneurysm rupture (3), but none of these conditions fulfill our criteria. It can be said that the number of reported cases has increased in recent years, probably due to improved neuroimaging techniques or the use of preoperative cerebrovascular evaluation in some centers.

#### **The Etiology of Concurrence; Chance or Underlying Pathogenesis**

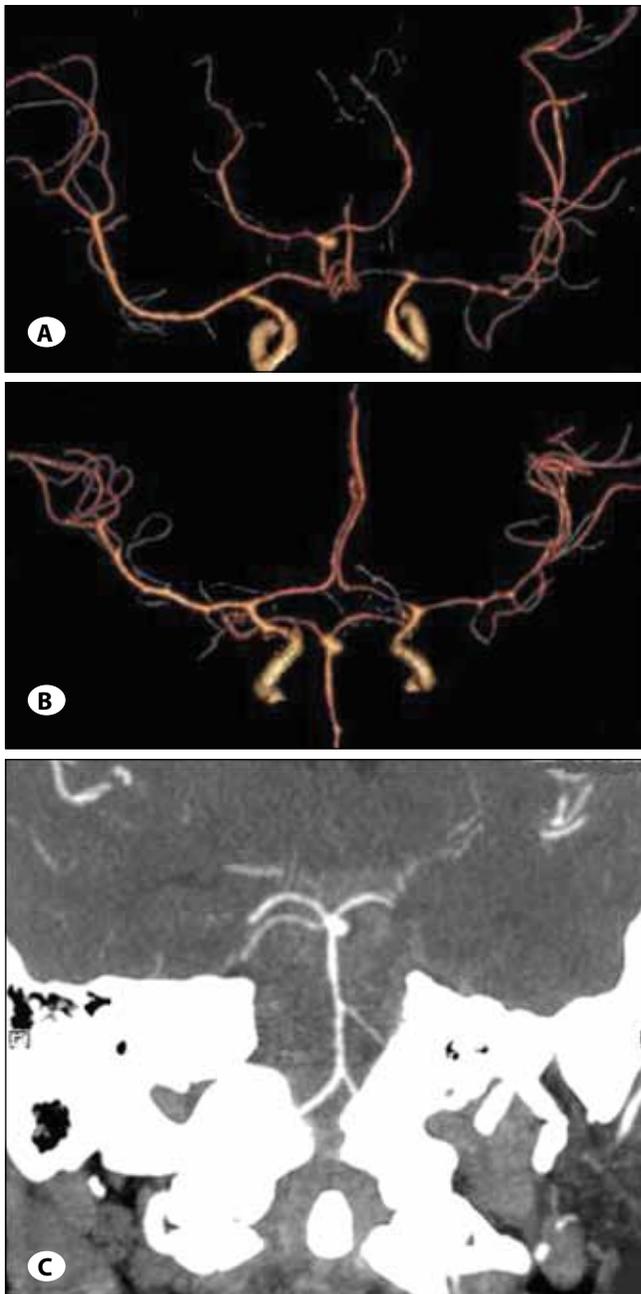
Several hypotheses have been proposed regarding the etiology of pituitary adenoma and aneurysm concurrence.

The hemodynamic changes seem to have the major role in creating these concurrent aneurysms (6).

Prolonged GH hypersecretion could play a potential role in the genesis of intracranial aneurysms in cases of secretory tumors (25). Excess growth hormone or insulin-like growth factor 1 affects the cerebral vascular wall, resulting in aneurysm formation (20). Acromegaly is accepted as a significant factor related to the prevalence of cerebral aneurysm particularly in male subjects, using multiple logistic regressions (20).

Direct mechanical contact has been mentioned as another etiological factor (9).

A retrospective review has speculated that such occurrences are merely due to chance and the risk is not greater than that among the general population (19).



**Figure 3:** Computed tomography angiogram demonstrating a saccular aneurysm at the left SCA-basilar artery junction (**A and B**); with the left superior cerebellar artery being not filled due to vasospasm (**C**).

**Table I:** Reported Cases of Coexisting Intracranial Aneurysms and Pituitary Adenomas

Author	Age	Sex	Aneurysm	Pituitary adenoma	Procedure
Hori et al., 1982 (9)	60	F	internal carotid artery	GH-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Tsuchida et al., 1983 (31)	55	M	anterior communicating artery	non-secreting adenoma	microsurgical clipping, TSS*
Fujiwara et al., 1991 (6)	69	M	internal carotid artery (P com junction)	non-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Fujiwara et al., 1991 (6)	59	M	internal carotid artery (P com junction)	prolactinoma	microsurgical clipping, tumor removal through craniotomy.
Fujiwara et al., 1991 (6)	47	F	internal carotid artery (ophthalmic segment)	GH-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Weir, 1992 (33)	35	M	bilateral intracavernous internal carotid arteries	GH-secreting adenoma	Expectant management for aneurysms, TSS*.
Hermier et al., 1994 (8)	58	M	anterior communicating artery	FSH and alpha-subunit Adenoma	microsurgical clipping, tumor removal through craniotomy.
Salpietro et al., 1997 (25)	71	F	intracavernous internal carotid artery	non-secreting adenoma	balloon ICA** occlusion, somatostatin analog.
Revuelta et al., 2002 (23)	60	F	internal carotid artery	non-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Laidlaw et al., 2003 (11)			right P com junction, left anterior cerebral	GH-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Sade et al., 2004 (24)	58	F	intracavernous internal carotid artery	GH-secreting adenoma	endovascular obliteration via GDC***, TSS*.
Yang et al., 2005 (36)	53	F	intracavernous internal carotid artery	prolactinoma	microsurgical clipping, tumor removal through craniotomy.
Curto et al., 2007 (5#)	61	F	bilateral intracavernous internal carotid arteries	GH-secreting adenoma	balloon ICA** occlusion, TSS*.
Bulsara et al., 2007 (2)	73	M	anterior communicating artery	non-secreting adenoma	microsurgical clipping, tumor removal through craniotomy.
Nadjem et al., 2007 (15)	42	M	vertebro-basilar arteries junction	non-secreting adenoma	Death before receiving treatment.
Seda et al., 2008 (27)	58	F	intracavernous internal carotid artery	GH-secreting adenoma	balloon ICA** occlusion and microsurgical clipping, TSS*.
Soni et al., 2008 (29)	53	F	intracavernous internal carotid artery	prolactinoma	balloon ICA** occlusion, cabergoline
Wang et al., 2009 (32)	61	F	supraclinoid internal carotid artery	prolactinoma	endovascular coiling, TSS*
Nishijima et al., 2010 (16)	40	F	intracavernous internal carotid artery	Cushing's disease	endovascular coiling, TSS*
Berker et al., 2010 (1)	35	F	intracavernous internal carotid artery	prolactinoma	endovascular stent-graft placement TSS*
Yamada et al., 2012 (35)	57	F	supraclinoid internal carotid artery	non-secreting adenoma	endovascular coiling, endonasal TSS*
Xia et al., 2012 (34)	48	F	intracavernous internal carotid artery	GH-secreting adenoma	endovascular stent-assisted coiling, endonasal endoscopic tumor resection
Sharifi et al., 2012 (28)	52	F	intracavernous internal carotid artery	non-secreting adenoma	Simultaneous resection of thrombosed aneurysm and adenoma via TSS

\*TSS; Transphenoidal surgery, \*\*ICA; Internal carotid artery, \*\*\*GDC; Guglielmi Detachable Coils.

# This patient had a concomitant intracranial meningioma.

### **Aneurysmal Rupture and Subarachnoidal Hemorrhage**

Subarachnoidal hemorrhage following TSS is a very rare condition. A series of 6 cases with SAH subsequent to TSS between 1964 and 2001 has been described, with the source being either from the residual tumor or from damaged sellar and arachnoid structures (13). In patients with concurrent cerebral aneurysm and pituitary adenoma, the risk of aneurysmal rupture always exists. The aneurysm could rupture either during recovery from anesthesia or the intraoperative maneuvers some surgeons employ for facilitating tumor delivery such as instillation of air or fluid into lumbar subarachnoidal catheter, bilateral jugular vein compression, and application of positive end expiratory pressure (10). Direct mechanical impact, or intraoperative hemodynamic changes can also cause perioperative bleeding.

In our center, only 1 case developed postoperative SAH among 180 cases of TSS for sellar lesions. Computed tomography (CT) angiogram revealed an aneurysm of basilar apex, accompanied by angiographic vasospasm of the left SCA. Unlike most similar conditions that were described in acromegaly patients with an anterior circulation aneurysm, the pituitary tumor was nonfunctional in the presented case and the aneurysm was located in the posterior circulation. None of previous studies have evaluated the potential effect of pituitary adenomas on the posterior cerebrovascular system. Hemodynamic changes induced by adenoma seem less probable in the posterior circulation compared to the anterior cerebrovascular system. Seeing that the intraoperative vascular insult was unlikely in the presented case, the resulting SAH can be considered as a very unfortunate simultaneous occurrence rather than a direct surgical complication.

### **Is Cerebrovascular Imaging Necessary Before Surgery for Pituitary Adenoma?**

In spite of the rarity, postoperative SAH can have such catastrophic outcomes that it deserves more consideration. Preoperative MR angiography/CT angiography is not currently obligatory in patients with pituitary adenoma, but in cases with the evidence of tumor expansion to the cavernous sinus or displacement and distortion of the vascular structures it can be of great value. A kind of cerebral angiography should also be performed without hesitation in any case in which the preoperative MRI shows a significant finding of aneurysm (6). Even in patients without such signals, it may be helpful to evaluate the vascular involvement, as well as simultaneously ruling out any potential concurrent aneurysm. Even so, this suggestion does not stand for routine screening CT/MR angiograms for all elective transsphenoidal surgeries. Recently, an MR angiography evaluation of the circle of Willis in acromegaly patients demonstrated that 17.3% of this group harbored newly diagnosed intracranial aneurysms (14). The authors of this article recommended that a neuroradiological evaluation of the intracranial circulation might be considered in the diagnostic work-up of patients affected with acromegaly (14). There is no suggestion for other kinds of secretory or non-secretory adenomas.

Open and endovascular treatment of unruptured intracranial aneurysms carry relatively low morbidity (19), and may be considered prior to performing other elective intracranial procedures like transsphenoidal surgery. Recently, transsphenoidal pseudocapsule-based extracapsular resection has been introduced as a better alternative compared to the traditional intracapsular approach, with emphasis on the detection and pretreatment of an adjacent unruptured intracerebral aneurysm (35).

To propose a clear-cut rule for neurovascular circulation imaging before adenoma surgery, it is necessary to perform investigations to determine the true prevalence of cerebral aneurysm and the risk of perioperative aneurysmal rupture in such cases. We strongly recommend that other centers publish their cases of perioperative aneurysmal hemorrhage in pituitary adenomas to provide a better view of the frequency of such an event that will help estimate the cost-benefit of performing routine non-invasive angiograms. In that case, it will be more feasible to comment for or against screening CT/MR angiography before elective TSS.

### **CONCLUSION**

Though anterior circulation aneurysms are shown to be more common in pituitary adenomas specially GH secreting tumors, posterior circulation aneurysms are very rare in such situations. Any detected intracerebral aneurysm needs to be occluded before surgery for pituitary adenoma or at the same session. Performing cerebrovascular imaging prior to surgical management of pituitary adenoma remains controversial and demands further investigations.

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