



Delayed Complications After Transsphenoidal Surgery for Pituitary Adenomas

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Key words

- Carotid pseudoaneurysm
- Cerebrospinal fluid leak
- Delayed complications
- Epistaxis
- Hydrocephalus
- Hyponatremia
- Hypopituitarism
- Pituitary
- Sinonasal complication
- Transsphenoidal surgery
- Tumor

Abbreviations and Acronyms

- CSF:** Cerebrospinal fluid leak
DSH: Delayed symptomatic hyponatremia
MRI: Magnetic resonance imaging

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INTRODUCTION

Pituitary adenomas are one of the most common primary intracranial tumors; lesions are noted in 16.7% of the population at autopsy and on fine-cut magnetic resonance imaging (MRI) studies.¹ When surgery is indicated, an endonasal transsphenoidal route is the preferred approach for accessing these tumors. Microscopic and endoscopic endonasal surgical techniques and their variations have been reported widely in the literature. Perioperative complications after transsphenoidal approaches to pituitary adenomas, including cerebrospinal fluid (CSF) leak, electrolyte imbalance, hormonal disturbance, infection, sinonasal complications, and vascular injuries, have been reported in many studies²⁻¹⁵; however, some complications after pituitary adenoma surgery can instead occur in a delayed fashion.¹⁶⁻²²

Perioperative complications after transsphenoidal surgery for pituitary adenomas have been well documented in the literature; however, some complications can occur in a delayed fashion postoperatively, and reports are sparse about their occurrence, management, and outcome. Here, we describe delayed complications after transsphenoidal surgery and discuss the incidence, temporality from the surgery, and management of these complications based on the findings of studies that reported delayed postoperative epistaxis, delayed postoperative cavernous carotid pseudoaneurysm formation and rupture, vasospasm, delayed symptomatic hyponatremia, hypopituitarism, hydrocephalus, and sinonasal complications. Our findings from this review revealed an incidence of 0.6%–3.3% for delayed postoperative epistaxis at 1–3 weeks postoperatively, 18 reported cases of delayed carotid artery pseudoaneurysm formation at 2 days to 10 years postoperatively, 30 reported cases of postoperative vasospasm occurring 8 days postoperatively, a 3.6%–19.8% rate of delayed symptomatic hyponatremia at 4–7 days postoperatively, a 3.1% rate of new-onset hypopituitarism at 2 months postoperatively, and a 0.4%–5.8% rate of hydrocephalus within 2.2 months postoperatively. Sinonasal complications are commonly reported after transsphenoidal surgery, but spontaneous resolutions within 3–12 months have been reported. Although the incidence of some of these complications is low, providing preoperative counseling to patients with pituitary tumors regarding these delayed complications and proper postoperative follow-up planning is an important part of treatment planning.

Some delayed complications are rare as well and reported only sparsely as case reports. Recently, Naunheim et al.¹⁶ published a retrospective series describing the complications associated with endoscopic surgery for paranasal and skull base pathologies in 58 patients. The authors classified complications as perioperative (within 1 week), early (1 week to 6 months), and delayed (after 6 months)¹⁶; however, because of the rarity of some of these complications, a large sample size and long follow-up period would be necessary to capture the true incidence and the management outcome for these complications. We define delayed postoperative complications as any complication occurring 48 hours or more after transsphenoidal surgery for pituitary adenomas. Using this definition, we reviewed the incidence, temporality, pathophysiology, and management of the delayed postoperative complications specific to transsphenoidal surgery for

pituitary adenomas in the literature and provide a summary of our findings.

CAUSES OF DELAYED COMPLICATIONS

Surgeons tend to focus on surgical outcomes and the common immediate postoperative complications when counseling patients preoperatively, but knowledge of delayed postoperative complications is important for preoperative counseling and follow-up planning for these patients. The choice of surgical visualization (microscopic vs. endoscopic), extent of surgical approach (standard vs. extended transsphenoidal), sellar versus parasellar tumor extension, heterogeneity of the reported series, and surgical team experience are some of the factors that may account for some of the variations in the incidence of the postoperative complications for pituitary adenomas. **Table 1** summarizes our review about the delayed complications

Table 1. Summary of Delayed Postoperative Complications After Transsphenoidal Surgery for Pituitary Adenomas

Complications	Incidence	Temporality After Surgery	Pathophysiology	Management
Delayed postoperative epistaxis	0.6%–3.3%	1–3 weeks	Injury to sphenopalatine artery or its posterior septal branch at the inferolateral corner of the sphenoid sinus	<ol style="list-style-type: none"> 1. Bedside nasal packing, balloon tamponading, or cauterization. 2. Embolization of the sphenopalatine artery or internal maxillary artery
Cavernous carotid pseudoaneurysm	1.1%	2 days–10 years	Injury to the paraclival or cavernous segment of the carotid artery	<p>Obliteration of the false wall and carotid preservation should be attempted. In many instances, carotid sacrifice cannot be avoided.</p> <ol style="list-style-type: none"> 1. Surgically, direct repair, high-flow EC–IC bypass with internal carotid artery ligation, or trapping 2. Endovascular treatment options include balloon occlusion, coil embolization, and flow diversion
Vasospasm	30 cases reported	8 days	<ol style="list-style-type: none"> 1. Violation of the arachnoid layer and intraoperative CSF leak leading to spillage of blood product into the subarachnoid layer 2. Direct arterial wall injuries 3. Hypothalamic injury 4. Electrolyte disturbance 	<ol style="list-style-type: none"> 1. Ruling out infections and seizures, correcting electrolyte disturbance, monitoring volume status and euvolemia 2. Permissive or induced hypertension 3. Vasopressors 4. Endovascular treatment (intra-arterial vasodilators and balloon angioplasty) in refractory cases
Delayed symptomatic hyponatremia	3.6%–19.8%	4–7 days	<ol style="list-style-type: none"> 1. Iatrogenic injury of the neurohypophysis during surgical exploration 2. Cerebral salt-wasting syndrome 3. Adrenocortical insufficiency 4. Hypothyroidism 5. Hyponatremia overcorrection 6. Volume overload 	<ol style="list-style-type: none"> 1. Measurement of serum and urine electrolytes and osmolality 2. Assessment of volume status and urinary output 3. Evaluation and analysis of a pituitary hormonal panel 4. Treatment should be initiated accordingly and may involve intravenous infusion of hypertonic saline, or fluid restriction
Hypopituitarism	3%–6.1%	1–6 months	Likely related to direct injury to the adenohypophysis	<ol style="list-style-type: none"> 1. Fasting full pituitary hormonal panel 48 hours postoperatively 2. Endocrinology consultation for any abnormal result for further management and future follow-up planning
Hydrocephalus	5.8%	Within 2 months	Arachnoid violation and blood product spillage into the subarachnoid space	<ol style="list-style-type: none"> 1. Re-exploration of CSF leak site, placement of a lumbar drain, or both 2. If the leak persists or the patient presents in a delayed fashion, appropriate workup including brain imaging should be initiated and definitive treatment with a shunt
Sinonasal complications	29.6% (Overall)	2 weeks–3 months	Iatrogenic related to surgical corridor	Careful surgical techniques and postoperative endoscopic nasal debridement in the clinic along with nasal saline spray to moisten the nasal cavity might help to improve some of these complaints

EC–IC, extracranial–intracranial; CSF, cerebrospinal fluid.

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