



## VASCULAR COMPLICATIONS OF ENDOSCOPIC TRANSPHENOIDAL APPROACH TO SELLAR BASE LESIONS

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### Abstract

**Objective:** Vascular complications are one of the most dangerous complications of endoscopic skull base surgeries. The aim of this study was to evaluate vascular complications of endoscopic transsphenoidal surgery in patients with sellar and parasellar lesions.

**Methods:** Between August 1997 and July 2023, a total of 5300 patients underwent endoscopic transsphenoidal surgery for skull base lesions at Kocaeli University Faculty of Medicine, Department of Neurosurgery and Pituitary Research Center. Patients with vascular complications during and after surgery were included into the study.

**Results:** We encountered 12 major vascular injuries, 116 epistaxis, and 50 operation site hematoma in our series.

**Conclusion:** Major vascular injuries are the most life-threatening complications. They can cause high mortality. The ways to prevent these injuries seems to have high experience and to investigate preoperative vascular evaluation in detail.

**Keywords:** *Endoscopic transsphenoidal surgery, complications, vascular, epistaxis, cavernous sinus.*

## Introduction

Skull base is one of the complex anatomical regions of the cranium.<sup>1</sup> Surgical treatment of skull base lesions can be challenging. Management of skull base lesions using endoscopic approaches has become increasingly common over recent years.<sup>2,3</sup>

Transsphenoidal approach to sellar base lesions is known to be associated with low complication rates.<sup>4,5</sup> Vascular complications, especially internal carotid artery (ICA) injuries, are one of the dangerous complications of endoscopic skull base surgeries.<sup>6</sup> Injury to the ICA accounts for approximately 1% of complications during transsphenoidal surgery.<sup>7,8</sup> Epistaxis, and operation site hematoma can also be shown in addition to these injuries.

The aim of this study was to evaluate and report the vascular complications of endoscopic transsphenoidal surgery in patients with sellar and parasellar lesions.

## Methods

### Patient Population

With approval from the institutional review board (07.09.2023 – GOKAEK-2023/14.35), medical datas, radiological images, and surgical videos retrospectively reviewed. Between August 1997 and July 2023, a total of 5300 patients underwent endoscopic transsphenoidal surgery for skull base lesions at Kocaeli University Faculty of Medicine, Department of Neurosurgery and Pituitary Research Center. Patients with vascular complications during and after surgery were included in the study. Patients who developed other complications as cerebrospinal fluid (CSF) leakage, meningitis, diabetes insipidus (DI), hydrocephalus, neurological deficit, and systemic complications were excluded from the study. The medical records of these patients were reviewed in terms of age, sex, surgical results, and follow-up data. Ethics committee approval was obtained for the study. Written informed consent was obtained from the families of all patients.

### Surgical Technique

All procedures were performed using standard endoscopic transsphenoidal and extended endoscopic transsphenoidal

approaches with an image-guided neuronavigation system. In addition to these, an extended approach was performed if necessary. The details of the surgical procedure have been described previously.<sup>9,10</sup> The surgical approach was through both nostrils. A 4-mm endoscope was used in patients. In the standard sellar approach, a small sphenoidotomy was performed to allow surgical manipulation. The sellar base was drilled and then the dura was opened. The aim of surgery is always maximum extent of resection; however, this is not possible in all cases.

An extended endoscopic transsphenoidal approach that uses the infrachiasmatic corridor is required for skull base lesions extending to the suprasellar area.<sup>11</sup> The difference of this approach from the standard approach is that the sellar base opening is extended superiorly.

If there is no CSF leak, no reconstruction is performed. In case of intraoperative CSF leakage, multilayer closure technique is performed.

### Complications

Within the scope of the study, epistaxis, postoperative sellar hematoma, and major vessel injuries were examined. In addition to this, interesting vascular pathologies or conditions resulting from them were also examined.

## Results

### Patients' characteristics

In this study, we focused on vascular complications of endoscopic transsphenoidal surgery and did not discuss the clinical outcome of surgeries and extent of tumor removal.

Majority of the patients had pituitary adenoma (87.9%), 189 patients (3.6%) had Rathke cleft cysts, 148 (2.8%) had craniopharyngioma, 116 (2.2%) had chordoma-chondrosarcoma, 98 (1.8%) had tuberculoma sellae meningioma, and 90 (1.7%) had other pathologies.

### Complications

We encountered 12 major vascular injuries in our series (Table 1). The half of these were ICA cavernous segment injuries. This is followed by paraclival carotid artery (Figure 1), basilar artery, and superior cerebellar artery injuries, respectively.

**Table 1.** Demographic characteristics of patients with tumor type, and location of vessel injuries

Number	Age	Gender	Tumor type	Location of vessel injury
1	27	Female	Pituitary Adenoma	ICA cavernous segment
2	51	Female	Chordoma	Paraclival carotid artery
3	18	Female	Pituitary Adenoma	ICA cavernous segment
4	47	Female	Chordoma	Paraclival carotid artery
5	27	Female	Chordoma	Superior cerebellar artery
6	33	Female	Giant Cell Bone Tumor	Paraclival carotid artery
7	32	Female	Epidermoid Tumor	Paraclival carotid artery
8	49	Female	Complex Meningioma	ICA cavernous segment
9	22	Male	Chordoma	ICA cavernous segment
10	53	Male	Pituitary Adenoma	ICA cavernous segment
11	42	Female	Craniopharyngioma	Basillary artery
12	39	Female	Chordoma	ICA cavernous segment

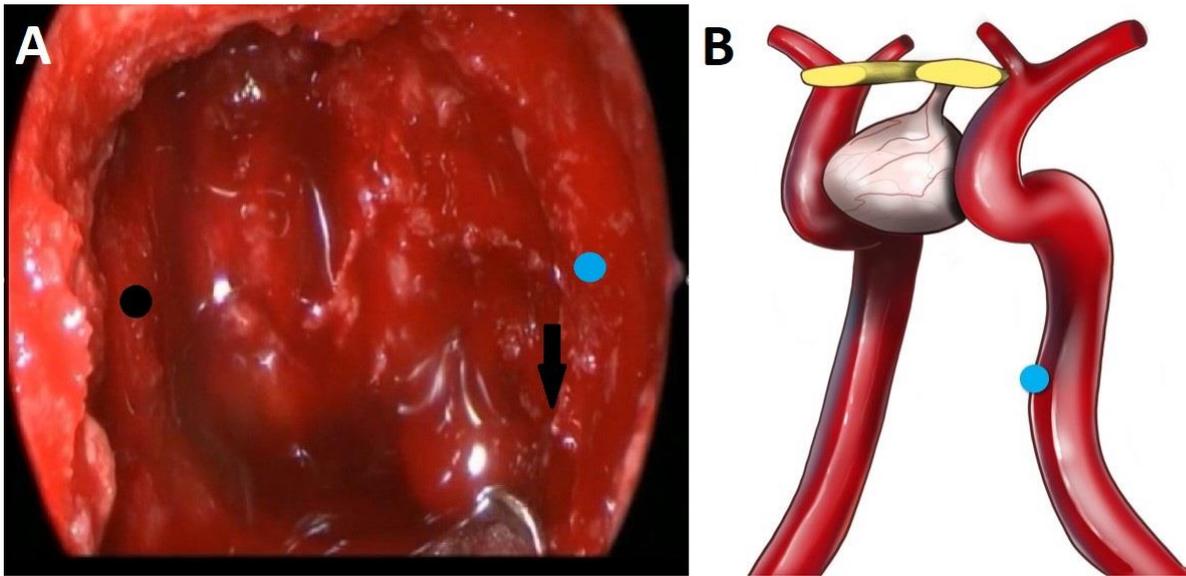
Chordoma was the most common tumor type in patients with major vascular injury and most of the patients were women. The bleeding of these 12 patients was reduced with antithrombotic agents during the operation. Subsequently, digital subtraction angiography (DSA) was performed on these patients and location of the injury was determined. The decision was made according to perfusion of the opposite

lobe of the brain and localization of the injury, and a stent was placed in the injured vessel lumen in 11 patients. In the remaining one patient, the lumen of the injured vessel was completely occluded.

Apart from major vascular injuries, we encountered epistaxis in 116 patients in the series. All of them were re-operated for sphenopalatine artery coagulation. Likewise, postoperative

operation site hematoma was observed in 50 patients. The hematoma was evacuated endoscopically in all of them. One of these 50 patients died during their postoperative follow-up.

Additionally, a transient ischemic attack was observed only in one patient and a newly developed thrombosed aneurysm was also observed in one patient.



**Figure 1:** Peroperative view of paraclival carotid artery injury **A)** Endoscopic view of operation site after evacuation the tumor. Black dot indicates right carotid artery. Blue dot indicates left carotid artery and black arrow indicates injured area of the paraclival carotid artery. **B)** Schematic view of pituitary and ICA. Blue dot indicates the left carotid artery and injured area.

## Discussion

The vascular complications, especially major vascular injuries, are the most feared and mortal complications in endoscopic skull base surgery.

In fact, minor vascular complications are the most commonly observed. The most common of these complications are cavernous sinus venous bleedings. The cavernous sinus is one of the first areas where tumors located in the sellar and parasellar region invade due to their close proximity. Since it is the area where venous blood collects, this close proximity increases the frequency of cavernous sinus bleedings. Almost all of these bleedings can be stopped by applying pressure. Surgicell or antithrombotic agents can be used. These 3 methods are sufficient for cavernous sinus bleeding.

Since epistaxis occurs in the postoperative period, it is one of the complications that negatively affects patient comfort compared to cavernous sinus bleeding. Because it requires reoperation. As it is known, the most frequently injured vessel causing epistaxis is the sphenopalatine artery. To reduce this complication as much as possible, the sphenopalatine artery localization should be well cauterized during the operation. Developing a hematoma in the operation area is more dangerous than previous complications. One should be alert to this complication as it may deteriorate the general condition of the patient and result in mortality. Recognition and evacuation as early as possible is quite important for the survival of the patient.

The most frightening of vascular complications are major vascular injuries. Paraclival carotid artery and ICA cavernous segment adjacent to the sellar region are the areas that can be injured most frequently in this type of surgery. Intravascular intervention is absolutely necessary in these injuries and hemostatic agents may be inadequate. Even during follow-ups, repeat angiographies should be performed and checked for the development of dissecting aneurysms. In the literature, dissecting aneurysms that develop after surgery are mentioned at the case level.<sup>12,13</sup> In our study, no mortality was

encountered in patients with major vascular injury. During the follow-up angiography results showed no dissecting aneurysm.

Increased experience in endoscopic transnasal surgery may reduce vascular complication rates. Likewise, detailed preoperative vascular evaluation may reduce vascular complication rates. Since the structure and trace of the vessels may be different in each patient, imaging methods for the vessels should definitely be used to avoid perioperative and postoperative vascular complications.

## Limitations

As a limitation, the study did not differentiate patients into primary and recurrent. In recurrent cases, adhesions may change the vascular trace. Further studies evaluating these cases separately may be considered.

## Conclusion

Major vascular injuries are the most life-threatening complications. They might cause high mortality. The ways to prevent these injuries seems to investigate a preoperative vascular evaluation in detail and to evaluate the cases by highly experienced clinicians.

## Conflict of Interest

The author have no conflicts of interest to disclose.

## Compliance with Ethical Statement

This study was performed with the approval of the local ethics committee (GOKAEK-2023/14.35).

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