Hemostasis through Extended Transsphenoidal Route for Subarachnoid Hemorrhage after Conventional Transsphenoidal Surgery for a Pituitary Adenoma

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Abstract

This report describes a 49-year-old male patient who presented with a pituitary adenoma extending to the suprasellar region. Subarachnoid hemorrhage (SAH) occurred after conventional transnasal transsphenoidal surgery for a non-functioning pituitary adenoma despite no suprasellar arachnoid membrane breakdown. Through extended transsphenoidal route, the suprasellar hematoma was removed and bleeding from a small vessel thought to be the branch of left superior hypophyseal artery was successfully controlled. Indeed, several case reports regarding this rare complication have been published, but the mechanism of SAH has never been identified and the prognosis was poor in most cases. This report illustrates the origin and mechanism of the bleeding clearly using the intraoperative video. This case suggests that immediate therapeutic intervention is necessary and extended transnasal transsphenoidal repeat surgery is useful for an appropriate hemostasis and removal of hematoma located in the suprasellar region.

Keywords: transsphenoidal surgery, subarachnoid hemorrhage, hypothalamic artery, tumor adhesion, tethering effect

Introduction

Transsphenoidal surgery has been considered an effective and safe procedure for the treatment of pituitary adenomas. The complication of postoperative subarachnoid hemorrhage (SAH) due to tumor removal has been believed to be extremely rare when the operative maneuver is restricted to gentle subcapsular tumor removal. We experienced this rare complication and could confirm the cause of SAH and appropriate removal of the hematoma by immediate postoperative repeat surgery via extended transsphenoidal surgery.

Case Report

History and examination

A 49-year-old man presented with an upper right quadrant visual disturbance of the right eye due to a macroadenoma with suprasellar extension. A conventional transsphenoidal surgery was performed; however, most of the tumors were not removed and his visual symptoms did not improve. The patient was referred to us for a second operation. Preoperative MRI demonstrated a tumor with the suprasellar extension compressing the optic nerve and chiasma (maximum diameter was 2.8 cm) (Figs. 1A and 1B). MRA was unremarkable without any possible lesions causing SAH (Fig. 1C). Hormonal
examination revealed severe adult growth hormone and gonadotropin deficiency. Goldmann perimetry confirmed the visual field defect that was previously identified.

Conventional endoscopic endonasal transspHENoidal surgery (cTSS) was performed with the diagnosis of clinically non-functional pituitary adenoma. The tumor was soft, and total tumor removal was achieved without any difficulties during surgery. No forcible traction was performed during surgery. Arachnoid membrane covering the upper surface of the tumor came down spontaneously, suggesting complete tumor removal without cerebrospinal fluid (CSF) leakage (Video 1; Videos are available online.)

**Postoperative course**

Although the patient looked unremarkable with normal consciousness level, routine postoperative CT was performed immediately after surgery. Unexpectedly, CT revealed a small subarachnoid hematoma in the suprasellar-prepontine cistern (Figs. 2A–2C). No symptoms due to his hematoma were observed at that time. However, the second CT was performed 1 hr later because the patient complained of headaches and a gradual deterioration of the visual field.

Fig. 1  (A and B) Preoperative MRI shows a sellar mass with significant upper extension. (C) Preoperative MRA identified no lesions that can cause subarachnoid hemorrhage.

Fig. 2  (A–C) CT taken just after the tumor removal shows unexpected small amount of the subarachnoid hematoma in the suprasellar–prepontine cistern. (D–F) The second CT shows the subarachnoid hematoma, which increased and spread into the ambient cistern and the right sylvian fissure.
It demonstrated that the subarachnoid hematoma increased in size and spread into the ambient cistern and the right sylvian fissure (Figs. 2D and 2E). We decided to perform a reoperation because of the enlargement of the hematoma and exacerbation of his clinical symptoms. Preoperative MRA confirmed that he had no saccular aneurysm, and we thought it was quite unlikely that our first manipulation led to the formation of any dissecting aneurysm on the major arteries, which needed clipping or wrapping. Thus, we chose extended endoscopic endonasal transsphenoidal approach (ext.TSS) for the management of the causative small vessels we assumed, instead of the craniotomy. We performed the wide osteodural opening over the sellar floor and presellar area (ext.TSS) to open the suprasellar cistern and to easily remove the hematoma that is mainly located in the suprasellar region (Figs. 3A and 3B).

We could identify an arterial bleeding from a small branch of artery, which was considered to be the branch of the left superior hypophyseal artery. We deliberately adapted the gelatin sponge as a hemostat, to avoid ischemic damage of the optic nerve by electrical coagulation (Video 2). No other source of bleeding was found by the careful inspection of the wall of the arteries, which could be observed after hematoma removal. The postoperative course was uneventful following the second operation. From day 3 to day 4, the patient complained of transient left hemianopia that disappeared with conservative therapy on day 5. Although MRA showed moderate vasospasm for about 2 weeks, the patient remained awake and alert, and did not show any obvious neurological deterioration later. Repeated MRA on day 14 showed resolution of vasospasm and no further morphological change of the arterial wall, suggesting the origin of the postoperative bleeding. He was discharged on day 22 without any additional symptoms.

Discussion

Microscopic or endoscopic transnasal transsphenoidal surgery has been widely used to remove pituitary adenomas because of its safety and efficacy. As compared to the microscopic approach, the endoscopic approach can give us a panoramic operative field. Moreover, visualization has dramatically improved with refinements to the optical apparatus. However, there are still some complications such as CSF leakage, meningitis, visual or pituitary functional decline, vascular injury, and nasal complications. Regarding vascular complications, the pterygopalatine or internal carotid artery (ICA) injury has been widely described. In contrast, intracerebral hemorrhage or SAH is considered to be extremely rare. This is particularly true when the operative maneuver for tumor removal is gentle and is limited to the sella turcica without any forcible traction of the upper tumor capsule consisting of the very thin compressed normal pituitary gland and arachnoid membrane. To the best of our knowledge, five papers have been published in which non-aneurysmal SAH occurred after TSS for the treatment of pituitary adenomas. In total, 14 patients experienced such events in these five papers, and the authors speculated that the SAH resulted from the residual tumor or the soft tissue within the sella when accompanied with a tear of the diaphragm and suprasellar arachnoid membrane.

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surgery because the patients showed progressive consciousness disturbances after TSS. In this case, postoperative angiography confirmed that the massive critical suprasellar SAH resulted from an accidentally complicated anterior communicating artery aneurysm. The authors hypothesized that the tumor capsule collapsed abruptly into the sella turcica as the bulk of the tumor was reduced, and may have exerted traction on the wall of the aneurysm or the anterior communicating artery adhered to the tumor capsule, which caused them to burst during surgery.

In contrast, Kuroyanagi et al. reported the case of a 59-year-old man, whose non-functional adenoma was removed by cTSS without any complications during surgery. However, the patient suffered from SAH postoperatively. Angiography showed no particular vascular lesion such as an aneurysm or arteriovenous malformation. The author speculated that small arteries adhered to the surface of the upwardly extending tumor capsule were injured by the same mechanism proposed by Tsuchida et al., and termed the mechanism “tethering effect,” which was introduced in an experimental study conducted by Thompson and Salcman. Thompson and Salcman demonstrated the experimental result in a dog model. They found that small perforating arteries branching from the large parent artery (ICA), which is tethered to the bone, can be injured by the abrupt movement of the brain, and hemorrhage from the small perforating artery could consequently occur. Matsuno et al. described a 42-year-old patient, in whom the suprasellar extended prolactin-secreting pituitary adenoma was operated upon. TSS was performed with manipulation only under the diaphragm and neither CSF leakage nor bleeding was observed during surgery. Nonetheless, postoperative CT showed massive SAH. The angiogram thereafter showed no aneurysm or arteriovenous malformation. However, when compared with the preoperative angiography, a small branch originating from the right ICA was not visualized. The patient died 21 days after the operation, and autopsy revealed the discontinuity of the internal elastic lamina of the ICA. They speculated that the small artery adhering to the tumor capsule was pulled out from the ICA by the tethering effect caused by the evacuation of the tumor mass, and SAH occurred as a result. Therefore, we also speculate that it is plausible that a similar tethering effect of the suprasellar small artery adhered to the tumor capsule could be the cause of the postoperative SAH occurred in our case. We think this may have occurred even if the surgical manipulation was basically confined to below the diaphragm and suprasellar arachnoid membrane,
and without any forcible traction of these structures as demonstrated in Video 1.

We conclude that critical suprasellar postoperative SAH can occur even after a relatively gentle TSS procedure for pituitary adenoma removal, although it might be extremely rare.

Conclusions

This is the first case report demonstrating clearly that injury of the suprasellar small artery can occur during the removal of the pituitary macroadenoma even by gentle tumor removal at TSS with the preservation of the suprasellar arachnoid membrane. Our experience suggests that immediate therapeutic intervention is necessary and extended transnasal transsphenoidal repeat surgery is useful for appropriate hemostasis and removal of hematoma located in the suprasellar region.

Conflicts of Interest Disclosure

The authors declare no conflicts of interest.

Supplementary Materials

Video1

Conventional endoscopic endonasal transsphenoidal surgery (cTSS) performed with the diagnosis of clinically non-functional pituitary adenoma.

Video2

The second surgery undertaken by extended endoscopic endonasal transsphenoidal surgery (eTSS) for removal of the postoperative suprasellar hematoma and hemostasis.

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