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Surgical Neurology International

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SNI: Neuroendoscopy

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Case Report

Combined simultaneous endoscopic endonasal and microscopic transventricular surgery using a port retractor system for giant pituitary adenoma: A technical case report

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Received : 16 November 2020
Accepted : 01 February 2021
Published : 08 March 2021

DOI
10.25259/SNI_826_2020

Quick Response Code:

ABSTRACT

Background: We report a case of a giant pituitary adenoma with marked extension into the third ventricle that was successfully removed using combined simultaneous endoscopic endonasal surgery (EES) and microscopic transventricular port surgery.

Case Description: A 47-year-old woman, who complained of memory disturbance, had a giant pituitary adenoma with marked extension into the third ventricle that was causing obstructive hydrocephalus. She underwent combined EES and microscopic transventricular surgery using a port retractor system. Most of the tumor was resected from the EES side with assistance from the transcranial side with minimum cortical trajectory damage. The tumor was completely excised without any complications.

Conclusion: For giant pituitary adenoma with marked extension into the third ventricle, combined simultaneous EES and transventricular surgery using a port retractor system is effective to maximize the extent of tumor resection while also preventing complications. Using port surgery on the transcranial side, microscopic secure dissection is possible with minimum additional cortical damage.

Keywords: Combined endoscopic endonasal surgery and transcranial surgery, Giant pituitary adenoma, Minimally invasive surgery, Port surgery

INTRODUCTION

Recently, excellent results of endoscopic endonasal surgery (EES) for pituitary adenoma have been reported.[3,4] However, EES for giant adenomas, which are generally defined as adenomas with a diameter of 4 cm or over, is still challenging because postoperative bleeding from the residual tumor or ischemic complications causes morbidity and mortality.[2,8,10] We report a case of a giant pituitary adenoma with marked extension into the third ventricle that was successfully

excised by means of combined simultaneous EES and microscopic transventricular surgery using a port retractor system.

CASE DESCRIPTION

A 47-year-old woman was admitted to a local hospital because of memory disturbance. Magnetic resonance imaging (MRI) showed a giant pituitary adenoma; therefore, she was referred to our hospital for more extensive diagnosis and specialized treatment. At the time of admission, mild cognitive deficit was revealed through a psychometric test: the scores of the Mini-Mental State Examination (MMSE) and Revised Hasegawa Dementia Scale (HDS-R) were 21/30 and 18/30, respectively. Her visual acuity was 1.0 (right) and 1.0 (left), and Goldmann perimetry testing revealed bitemporal hemianopia. In addition, bilateral papilledema was detected. A blood test showed hyperprolactinemia (PRL 386 ng/ml, normal range 4.1–28.9) and hypothyroidism (free T4 0.66 ng/ml, normal range 0.9–1.7; free T3 2.0 ng/ml, normal range 2.3–4.0), but no abnormality otherwise. MRI revealed an intrasellar and suprasellar contrast-enhanced mass lesion (maximum diameter of 55 mm) extending into the third ventricle causing the obstructive hydrocephalus [Figure 1a and b]. Because of the presenting bilateral papilledema, an Ommaya reservoir was urgently placed to relieve the obstructive hydrocephalus, and subsequent radical tumor resection was planned. While waiting for the radical tumor resection, we tried cabergoline therapy, intending to decrease the tumor mass because the patient had hyperprolactinemia. However, the size of the tumor did not change.

Regarding the surgical strategy, we expected that most of the tumor could be removed by EES; however, we were afraid of the risk of postoperative hemorrhage from the residual tumor due to the marked tumor extension into the third ventricle. Therefore, we planned combined simultaneous EES and transventricular surgery so that we could resect or at least assist resection from above the uppermost part of the tumor. For the transventricular surgery, we selected the transcortical route because of the presence of ventriculomegaly, and we additionally used a port retractor system, the ViewSite Brain Access System (Vycor Medical Inc., FL, USA), to minimize the surgical trajectory.

The operation was started from above and below at the same time. The operative setting is shown in [Figure 2]. The patient was in the supine position. The head was elevated approximately 10 degrees, slightly tilted to the left, and slightly rotated to the right.

EES

When indicated, EES is typically performed in all cases of 3- or 4-handed surgeries done by an interdisciplinary team

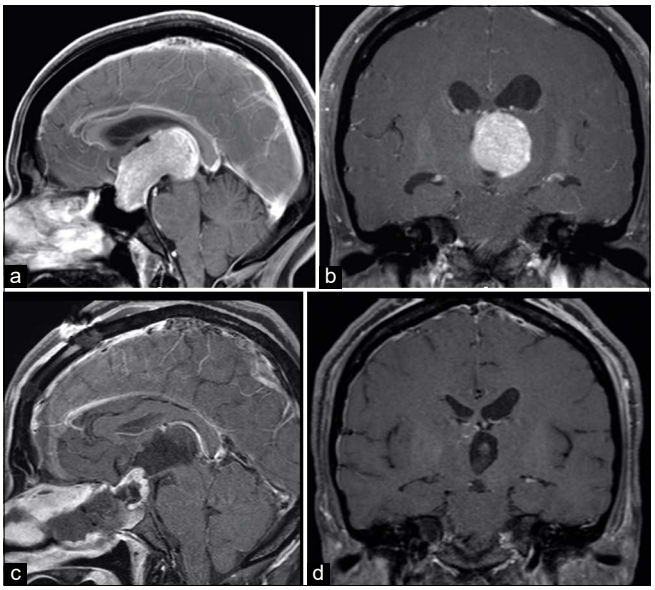

Figure 1: Contrast-enhanced T1-weighted images show an intrasellar and suprasellar pituitary adenoma extending into the third ventricle (a and b). The postoperative contrast-enhanced T1-weighted images show complete resection of the tumor (c and d).

of neurosurgeons and otolaryngologists at our hospital. In this case, the middle turbinate was gently lateralized, and the nasal septum mucosa was incised and elevated. After the resection of the posterior bony nasal septum, the anterior wall of the sphenoid sinus was widely opened using a drill. Next, the skull base bone resection area was enlarged to expose the dura mater from the sellar floor to the frontal base. The area of the bone resection included the sellar floor, the tuberculum sellae, the medial part of the bilateral carotid prominence, and the medial opticocarotid recess, facilitating resection of the suprasellar and lateral compartments of the tumor.

Microscopic transventricular surgery using a port retractor system

Bicoronal skin incision. After small right frontal craniotomy, the port retractor, 17 mm x 11 mm in distal opening width and 70 mm in length, was inserted into the right anterior horn along the tract of the ventricular catheter that was inserted under the navigation guide [Figure 3a].

The direction of the port retractor was aiming to the most upper and dorsal part of the tumor, which was the most difficult area to reach from the endonasal side [Figure 3b].

The port retractor was connected with the self-retaining Budde Halo Retractor System. Then, the tumor was confirmed beyond the foramen of Monro. Due to the obstructive hydrocephalus, the foramen of Monro was enlarged; therefore, the working space was sufficient for

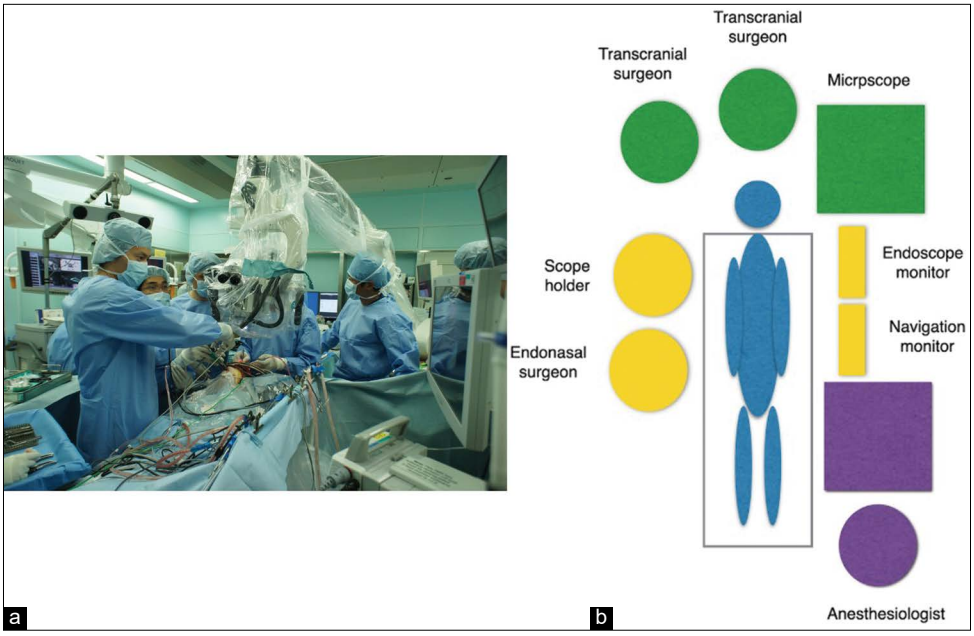

Figure 2: The photograph (a) and schematic diagram (b) show the setup for the combined endoscopic endonasal surgery (EES) and microscopic transcranial (transventricular) surgery. During the operation, the two surgeons performing the transcranial surgery are on the cranial side and the two surgeons performing the EES are on the right side of the patient. On the left side of the patient, the microscope is placed most cranially, then the monitors of the endoscope and navigation are placed, and the anesthesiologist is standing caudally.

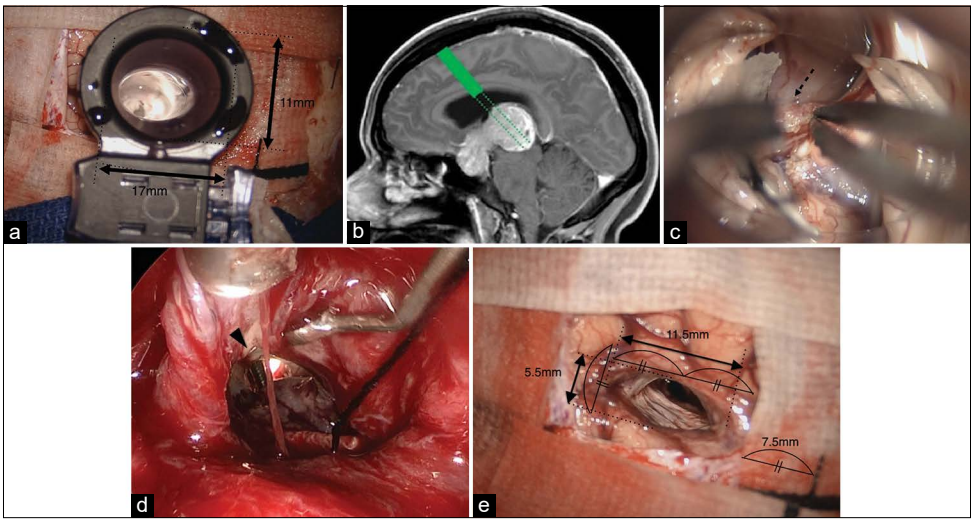

Figure 3: (a) After the ventricular catheter is inserted through the right anterior horn and the outflow of the cerebrospinal fluid is confirmed, a port retractor (ViewSite Brain Access System) (17 mm × 11 mm in distal opening width, 70 mm in length) is inserted along the tract of the tube. The port retractor is connected with the Budde Halo self-retaining retractor system. (b) The direction (green dotted line) of the port retractor (green rectangle) for the microscopic transventricular approach. The direction of the port retractor is aiming to the most upper and dorsal part of the tumor, which is the most difficult area to reach from the endonasal side. (c) Microscopic view through the inserted port retractor. The tumor (arrow) is observed beyond the foramen of Monro (dotted line). Due to the obstructive hydrocephalus, the foramen of Monro is dilated; therefore, the working space is sufficient for following the procedure through the foramen of Monro. (d) Microscopic view through the port retractor. The choroid plexus (dotted arrow) and surrounding veins are attached to the upper surface of the tumor and are detached by means of microscopic bimanual dissection using a thin tip bipolar coagulator and suction. (e) Endoscopic view from the EES side. During the tumor resection through EES, the surgical instruments from the cranial side are seen through the small defect of the diaphragma sellae. (f) Microscopic view after the removal of the port retractor at the end of the tumor resection. The trajectory injury is minimal, and the size of the trajectory is calculated from the width of the neurosheet in the picture; the length and width of the trajectory are 11.5 mm and 5.5 mm, respectively.

following the procedure through the foramen of Monro [Figure 3c]. To facilitate to get access the most upper and dorsal part of the tumor, the thin anterior septal vein was sacrificed and choroidal fissure was dissected (transchoroidal approach) to expand transforaminal route posteriorly.

Combined EES and microscopic transventricular surgery using the port retractor system for tumor resection

Most of the tumor was resected mainly from the EES side, and the resection was assisted from the transventricular surgery side. After the incision of the sellar dura, a soft and fragile tumor, typical of a pituitary adenoma, was removed with a curette or by suction. After resection of the intrasellar part of the tumor, the suprasellar part was resected under visualization with a 30-degree angled scope. After the lower part of the tumor was debulked by ESS, the upper part gradually descended. During the descent of the tumor by ESS, on the craniotomy side, the adhered surrounding blood vessels or choroid plexus around the foramen of Monro were dissected from the tumor capsule or the diaphragma sellae (hereafter, the diaphragma) by means of bimanual dissection using a thin tip bipolar coagulator and suction [Figure 3d], and at the same time, hemostasis was conducted for some small venous bleeding. However, the surgical procedure became easier by EES but more difficult through transventricular route as time goes by because the tumor got closer to the EES side but became invisible from the transventricular side as the tumor descended to the direction of the sella [Figure 3b]. Finally, the diaphragma on the top of the tumor was lowered to the sellar floor, although a small defect of the diaphragma appeared during the procedure [Figure 3e], which meant that most parts of the tumor were located under the diaphragma except for a small tumor compartment. The small defect of the diaphragma was sealed with fibrin glue-soaked Gelfoam® (Pfizer, NY, USA) and coated with a nasal septum mucosa flap prepared in advance.

After the tumor resection, the cortical damage by the port retractor was minimal [Figure 3f]. The postoperative MRI showed complete resection of the tumor [Figure 1c and d].

Postoperatively, transient insufficiency of the adrenocortical axis and transient diabetes insipidus were encountered; therefore, supplement therapy was done for 3–6 months. The preoperatively presented insufficiency of the thyroid axis was unchanged after the surgery; thus, only levothyroxine was given at the 2-year follow-up after the surgery. The postoperative PRL level was 13.6 ng/ml at 2 months after the surgery. The preoperative cognitive dysfunction had completely resolved (MMSE: 29/30, HDS-R: 30/30), and the visual field was almost normalized 2 weeks after the surgery. The patient returned to normal work. The pathological diagnosis was pituitary adenoma with positive staining for LH and PRL. The MIB-1 labeling index was below 1%.

DISCUSSION

Despite recent advancements in EES, surgery for giant pituitary adenoma is still challenging. The mortality rate after EES for giant pituitary adenoma was reported as still being 5.5%.[11] Subsequent bleeding from the residual tumor or injury of a perforating artery was the major cause of morbidity. To prevent subsequent bleeding, complete or at least subtotal resection should be the aim; however, the surgical dilemma is that radical resection can cause ischemic complications or visual dysfunction due to injury to the neurovascular structures, including perforated arteries. Combined simultaneous EES with transcranial surgery is one of the methods of choice to maximize the extent of resection in selected patients with giant pituitary adenoma,[15,16] At the same time, this approach can improve safety due to improved visualization of the blind area from another side.[15] Numerous combinations of endonasal and transcranial surgery have been reported; microscopic TSS or EES with microscopic or endonasal transcranial surgery.

Combined microscopic TSS with microscopic transcranial surgery

Combined surgery using microscopic TSS and microscopic transcranial surgery was reported by Loyo *et al*.,[13] and combined endoscopic TSS and microscopic transcranial surgery was reported by Nishioka *et al*.[16] Combined surgery using microscopic TSS and microscopic transcranial surgery needs two microscopes, resulting in one microscope interfering with another in the limited space. Therefore, combination of endoscopic TSS and microscopic transcranial surgery is more comfortable for surgeons.[15]

Combined EES with microscopic transcranial surgery

Kuga *et al*.[12] reported the efficacy of EES with simultaneous transcranial approach assistance: they treated three patients with giant pituitary adenoma, no major complications occurred, and near-total or subtotal resection was accomplished in all the patients. In our present case, most of the tumor was resected from the EES side, and the resection was assisted from the transcranial side, because, as reported by Kuga *et al*., the visualization and maneuverability of the instruments are better in EES than in transcranial surgery, moreover, endonasal tumor resection below the diaphragma sellae is safer than transcranial resection from above because critical neurovascular structures are protected by the diaphragma sellae. On the other hand, the potential problems were invasiveness, risk of infection, and additional craniotomy-related complications.[12] Meanwhile, using a port retractor system, as in the present case, those potential problems can be minimized.

Combined EES and endoscopic supraorbital keyhole surgery

Nagata *et al*. reported the efficacy of combined endoscopic supraorbital keyhole surgery and EES for suprasellar lesions. Endoscopic use from above and below is promising and advantageous in terms of limited space interference between the nasal and transcranial sides and ergonomics for surgeons on both sides. However, the disadvantage of this method is that a supraorbital keyhole approach is not suitable for a giant adenoma with marked extension into the third ventricle, as in the present case.

Combined microscopic TSS and endoscopic transventricular surgery using ventriculoscope

Several reports have been published on combined EES and endoscopic transventricular surgery using a ventriculoscope.[5,9,17,19] However, devices available to be used with a ventriculoscope are limited, so the decompression of the tumor is difficult and is limited to the technique of pushing out the tumor with an endoscope or a balloon.[17] Therefore, using this method, safe and effective dissection such as in microscope-based surgery is not possible.

On the other hand, in our method of using microscopic transcranial surgery, we can assist from the transcranial side more effectively than in surgery using an endoscope because of the better maneuverability of the instruments.

Combined EES with microscopic transventricular surgery using a port retractor system

No reports have hitherto been published on EES and microscopic transventricular surgery using a port retractor system for a giant pituitary adenoma. The trajectory injury on the cerebral cortex can be minimized using a port retractor system for deep-seated intra-axial or intraventricular lesions.[1,18] The ViewSite Brain Access System is transparent plastic, has an elliptical tip opening, and is designed to gently divide the white matter when inserting the retractor to reduce tissue damage.[6,7,18] In fact, in our present case, the trajectory damage was minimal. Moreover, as for surgery using a port retractor, which is associated with limited surgical space, microscopic surgery had better instrument maneuverability and showed better surgical results than those of endoscopic surgeries previously reported in the literature.[7,14] Therefore, at present, we believe that microscopic surgery using a port retractor is more advantageous than endoscopic surgery in the case of intraventricular lesions.

In this combined surgery, the advantage of ESS over microscopic transventricular surgery is that instrument maneuverability is better in EES because no factor limits surgical space such as port retractor or foramen Monro. In addition, as the lower part of the tumor is debulked by EES, the upper part gradually descends, therefore, the surgical procedure becomes easier by EES but more difficult through transventricular route as time goes by because the tumor gets closer to the EES side but become invisible from the transventricular side as the tumor descends to the direction of the sella. This can be understandable to see [Figure 3b]. Because of these reasons, most of the tumor was resected from EES route and assisted the resection through the transventricular route.

On the other hand, the advantage of the microscopic transventricular surgery over EES is the direct access to the upper and dorsal surface of the tumor, which cannot be observed by EES side. However, transventricular approach angle through the foramen of Monro to the upper and dorsal surface was very steep in this case, transchoroidal dissection posteriorly extending the foramen Monro was useful to facilitate to get access to this area.

CONCLUSION

For a giant pituitary adenoma with marked extension into the third ventricle, combined simultaneous EES and microscopic transventricular surgery is effective to maximize the extent of tumor resection while at the same time preventing complications. Using a port retractor system for the transcranial side, microscopic secure dissection is possible with minimum additional cortical damage.

Acknowledgments

The authors thank Dr. Alexander Zaboronok, Department of Neurosurgery, and Ms. F. Miyamasu of the Medical English Communications Center of the Faculty of Medicine, University of Tsukuba, for manuscript revision.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Yamada E, Akutsu H, Kino H, Tanaka S, Miyamoto H, Hara T, *et al*. Combined simultaneous endoscopic endonasal and microscopic transventricular surgery using a port retractor system for giant pituitary adenoma: A technical case report. Surg Neurol Int 2021;12:90.