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Case Report

A minimally invasive supraorbital keyhole approach through superciliary arch for giant olfactory Groove angiopericytoma: case report

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Abstract

We sought to demonstrate a giant hemangiopericytoma within the olfactory groove resected by a minimally invasive supraorbital keyhole approach through superciliary arch, which is commonly used to remove relatively small meningioma, pituitary adenoma and craniopharyngioma. A 50-year-old female presented with a 1-year history of progressive headaches, anosmia, hyposmia, and visual deterioration. Anosmia and visual impairment were found by physical examination. The magnetic resonance imaging (MRI) scan demonstrated a large irregularly shaped intra-dural mass at bottom of right frontal lobe. A minimally invasive supraorbital keyhole approach through superciliary arch is performed for resecting this giant tumor. Surgical complications and degree of resection were recorded to evaluate the efficacy of this surgical method. Histological examination confirmed a diagnosis of hemangiopericytoma originating from the olfactory groove. Gross total resection of the intracranial hemangiopericytoma was possible with minimal brain retraction. Simpson grade I was achieved, and there were no presentation of new neurologic deficits, postoperative hematomas, and cerebrospinal fluid leakage in patient. We suggested that it is worthwhile a try to remove giant olfactory groove hemangiopericytoma by the minimally invasive supraorbital keyhole approach through superciliary arch, allowing for minimal damage of normal brain parenchyma, and improving prognosis.

Keywords: Hemangiopericytoma; Invasive; Supraorbital keyhole approach; Superciliary arch; Olfactory groove

Abbreviations: CSF: Cerebro Spinal Fluid; CT: Computed Tomography; MRI: Magnetic Resonance image

Introduction

Hemangiopericytoma of the central nervous system, also known as vascular pericytes tumor, which is a rare mesenchymal tumor which derive from malignant transformation of pericytes. Hemangiopericytomas comprise less than 1% of all the intracranial tumors [1]. Because of hemangiopericytomas with abundant blood supply, the surgical removal can carry significant risk. The Bi-coronal frontal approach, frontolateral approach, unilateral tailored fronto-orbital approach and invasive interhemispheric approach are usually used for hemangiopericytomas located in the olfactory groove, with good outcomes [2-8]. The supraorbital keyhole approach through superciliary arch incision for anterior midline skull base lesions has become increasingly, especially for relatively small meningiomas [9-19]. However, few articles have addressed the utility of the superciliary arch incision in the treatment of intracranial hemangiopericytomas. Therefore, we performed a minimally invasive supraorbital keyhole approach through superciliary arch for microsurgical resection of intracranial hemangiopericytoma. The idea behind this technique is to achieve an effective surgical resection with less brain damage.

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Case Description

A 50-year-old female presented with a 1-year history of progressive headaches, anosmia, hyposmia, and visual deterioration. A comprehensive review of the systems and the physical examination were negative, except anosmia and visual impairment. The magnetic resonance imaging (MRI) scan demonstrated an irregularly shaped 6.1× 5.2 × 5.2cm intra-dural mass at bottom of right frontal lobe, which was enhanced by gadolinium contrast with the cork-screw type of intra-tumoral vessels, highly suspicious of hemangiopericytoma or meningiomas arising from the olfactory groove Figure 1 A-C. The skull was free of mass invasion.

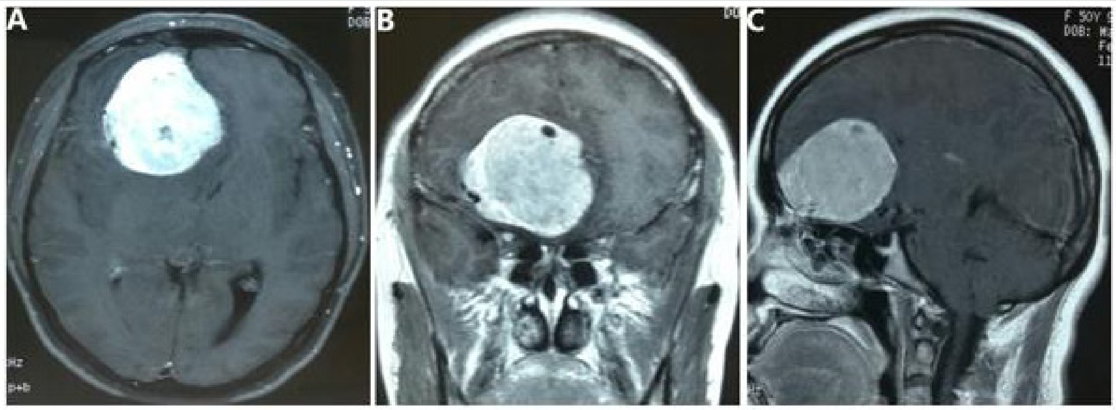

Figure 1: Preoperative MR images.

A large intra-dural mass at bottom of right frontal lobe was heterogeneously enhanced T1-weighted axial, coronal, and sagittal contrast MRI, with the cork-screw type of intra-tumoral vessels (A, B and C).

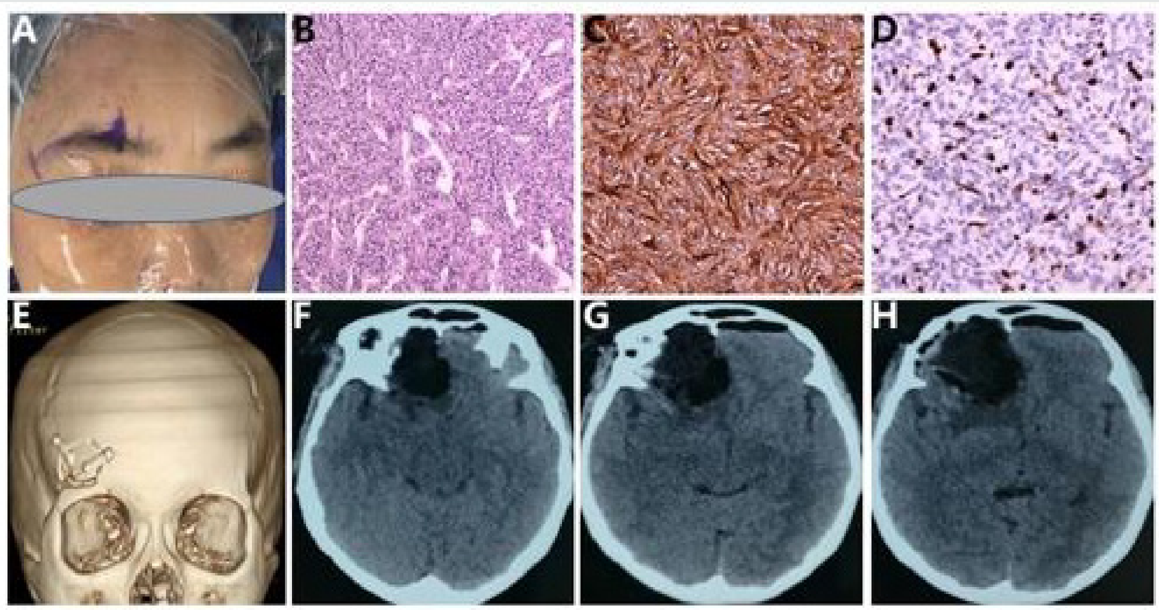

Figure 2: Intraoperative photographs, histological examination, and postoperative CT images.

The minimally invasive supraorbital keyhole approach through superciliary arch was used to remove the tumor (A). Hematoxylin and eosin staining showed that tumor cells arrayed closely with an average nuclear division of about 3/10HPF, and thin-walled blood vessels scattered among tumor cells (original magnification x100) (B). Most tumor cells are strongly positive for CD 34 (C) and about 67% positive for Ki-67 (D) on immunohistochemical staining (original magnification x200). The postoperative computed tomography (CT) confirmed the minimal eyebrow incision (E), and the complete removal of the tumor at six hours following operation (Figure F, G and H).

To remove mass and reduce brain damage, we decided using a minimally invasive supraorbital keyhole approach through superciliary arch Figure 2A. After general anesthesia, the patient is placed supine on the operating table with their head fixed in a three-pin Mayfield head holder. The head of patient is elevated until exceeding the level of the thorax, and retroflexed 15-30°. The skin is incised laterally from the supraorbital incisura within the eyebrow in a lateral-to-medial direction Figure 2A. Following the skin incision, the subcutaneous dissection is continued in the frontal direction to achieve optimal exposure of the frontolateral supraorbital area. The frontalis muscle is then cut with a monopolar knife parallel to the orbital rim in a medial-to-lateral direction. A single hole is made using a highspeed drill at the level of the frontal skull base. A minimal craniotomy is carried on using a high-speed craniotome, which cut the surface within a size of approximately 25×20mm. The dura is opened in a simple “C” shape and retracted in a basal direction. With careful mobilization of the frontal lobe, the deep subarachnoid cisterns could be reached without using an elevator. After release of cerebrospinal fluid (CSF), the tumor is approached in a retractor-free manner and is carefully removed under microscopic visualization, using cottonoids to protect brain during dissection. At the same time, the ethmoidal arteries are coagulated for reducing bleeding during the dissection. Careful dissection between the tumor and neurovascular structures usually requires a great amount of time and effort. A gross total resection of giant hemangiopericytoma was carried out with minimal brain retraction and minimal skull lesion Figure 2E. After tumor was removed with Simpson grade I, the dura was reapproximated with watertight closure and dura anchoring, as well as biologic glue applied. The bone flap is fixed back in place by titanium screw Figure 2E. Finally, the wound is closed with 2-0 Vycril and 3-0 Nylon.

The histopathologic result revealed that that tumor cells arrayed closely with an average nuclear division of about 3/10HPF, and thin-walled blood vessels scattered among tumor cells Figure 2B. The tumor cells were positive for CD34 and Ki67 by immunohistochemical staining Figure 2C & D. There were no surgical complications. Postoperatively, the patient did not present any increased neurological impairment except anosmia and visual impairment. The postoperative computed tomography (CT) confirmed the complete removal of the tumor at six hours following operation (Figure 2 F-H).

At discharge, the patient was ambulated independently without headache. She was referred to a radiation oncologist for adjuvant therapy. Her vision significantly improved, and her olfactory function were slightly improved at 6 months after operation. The scar within the patient’s right eyebrow is barely visible. The MRI scan also confirmed the complete removal of the hemangiopericytoma at six months postoperatively (Figure 3 A-C).

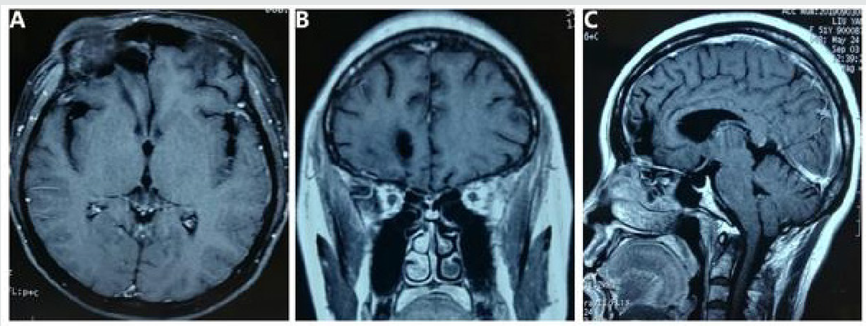

Figure 2: Postoperative MR images.
Magnetic Resonance scan (6 months postoperatively) revealed a complete removal of the tumor on T1-weighted axial, coronal, and sagittal contrast images (A, B and C).

Discussion

Intracranial hemangiopericytomas are very rare vascularized mesenchymal tumors with an incidence of less than 1% [1], and they represented 2.5% of all meningeal tumors [20]. Hemangiopericytomas are highly vascular tumors, which derived from pericytes around capillaries and postcapillary venules. Up to now, only one case of Hemangiopericytoma derived from olfactory groove was previously reported [2]. We added another case of giant hemangiopericytoma originating from olfactory groove, which was removed by a minimally invasive supraorbital keyhole approach through superciliary arch.

Though there was no specificity in brain CT and MRI for most tumors originated from the anterior skull base [21-23], the origination of huge tumors could be presented by MRI [24]. The diagnosis of tumor originating from olfactory groove was highly recommended by MRI in this patient. However, it is extremely important distinguishing intracranial hemangiopericytoma from meningioma in the anterior skull base because surgical resection of intracranial hemangiopericytoma will take a more bleeding risk than resection of meningioma. The previous brain MRI studies demonstrated that the cork-screw type of intra-tumoral vessels suggested intracranial hemangiopericytoma [21,24], whilst the spoke-wheel type of intra-tumoral vessels seemed more like meningioma25. Presenting the cork-screw type of intra-tumoral vessels in MRI Figure 1 of this patient also reasonably suggested the diagnosis of hemangiopericytoma, hinting neurosurgeon need consciously consider approaches and prevention postoperative complications.

Traditional approaches used to resect tumors of anterior skull base, especially for larger tumors, include subfrontal unilateral craniotomy, subfrontal bilateral craniotomy, interhemispheric approach, bifrontal approach pterional craniotomy, and craniotomy with adjuvant radiotherapy [3,4,6,8,26-29]. The supraorbital keyhole craniotomy has been developed for reducing skin incision, bony exposure, soft-tissue damage, and improving prognosis of patients with frontal base tumors by lots of surgeons [9-19,30-33]. Its safety and efficacy are comparable to those of conventional craniotomies for small size intra-axial lesions (such as gliomas, metastatic carcinomas, radiation necroses, intracranial contusion hematomas, and cavernomas), and small size extra-axial lesions (such as meningioma, craniopharyngioma, pituitary adenomas, aneurysms) in the anterior or middle cranial fossa [9-19,30-33]. Giant tumors of anterior skull base favor to invade nerves, vessels, cerebral dural sinuses and other critical neuroanatomical areas surrounding tumors [5].

In order to remove these giant tumors, neurosurgeons usually choose the bilateral subfrontal craniotomy and the unilateral subfrontal craniotomy with/without adjuvant radiotherapy [2-5]. The previous studies also reported that surgeons tried to grossly resect giant olfactory groove meningiomas by unilateral tailored fronto-orbital approach and invasive interhemispheric approach [7,8]. Up to now, only one case of intracranial hemangiopericytoma arising from the olfactory groove was gross totally resected by Bi-coronal frontal craniotomy [2]. However, these approaches usually require more operative time, and need a large bony defects and long skin incisions, which might be relevant with poor prognoses. We first tried to remove giant olfactory Groove angiopericytoma through the minimally invasive supraorbital keyhole approach through superciliary arch. Postoperative complications of this minimally invasive craniotomy usually include leakage of CSF, supraorbital hypesthesia, palsy of the frontal branch of the facial nerve, wound healing disturbance or wound infection, blindness and hemiplegia [33]. Except for supraorbital hypesthesia, other postoperative complications did not occur in our patient with this minimally invasive supraorbital keyhole approach through superciliary arch.

We believe that this minimally invasive supraorbital keyhole approach through superciliary arch is a good choice for hemangiopericytoma in the olfactory groove due to the good outcome on the postoperative recovery. This approach has some advantages: a minimal skin incision, minimal bony exposure, minimal soft-tissue trauma, and less damage to olfactory nerve. Gross total resection is perfectly possible with minimal brain retraction. Concentration, familiar with anatomical structure and reliable hemostasis technology are needed to resect tumor in order to avoid injuring intracranial neurovascular structures using this minimally invasive supraorbital keyhole craniotomy through superciliary arch.

Conclusion

Intracranial hemangiopericytomas are rare tumor which are highly vascular tumors. The surgical removal can carry significant risk. In this case, the minimally invasive supraorbital keyhole approach through superciliary arch provides an effective and safe route for giant hemangiopericytoma in the olfactory groove with little or no need for brain retraction. Base on familiar with anatomical structure and reliable hemostasis technology, total resection of the tumor with abundant blood supply in the anterior skull base, can be achieved with minimal invasive supraorbital keyhole approach through superciliary arch.

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Disclosure

The authors have no conflicts of interest to disclose.

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