

# Extracranial–intracranial bypass in medial sphenoid ridge meningioma associated with severe stenosis of the intracranial segments of the internal carotid artery

## A case report

Yabo Huang, MD, Zhong Wang, MD, Qingdong Han, MD\*

### Abstract

**Rationale:** Tumor resection and extracranial-intracranial bypass concerning medial sphenoid ridge meningioma associated with severe stenosis of the internal carotid artery (ICA) of intracranial segments has been rarely presented. Effective treatment as to the complex lesions may be complicated. Tumor resection and cerebrovascular protection should be both taken into consideration.

**Patient concerns:** We presented one case of medial sphenoid ridge meningioma associated with severe stenosis of the internal carotid artery of intracranial segments. The patient suffered hyperthyroidism, mirror-image dextrocardia and congenital heart disease atrial septal defect simultaneously.

**Diagnoses:** Before the neurosurgical treatment, the colleagues of department of cardiac surgery, anesthesiology and respiratory medicine agreed on our plan of resecting the tumor following the comprehensive evaluation of basal clinical conditions in the patient. For reducing the bleeding intraoperatively, the interventional branch performed digital subtraction angiography(DSA) and found collateral anastomosis between the supplying vessels of left middle meningeal arteries and anterior choroid arteries. No preoperative interventional embolization was determined considering the risk of cerebral ischemia.

**Interventions:** The following subtotal resection of medial sphenoid ridge meningioma and left extracranial-intracranial bypass were carried out. Additionally, ipsilateral decompressive craniectomy was done. Post-operative imaging Computed tomography (CT), Computed tomography angiography (CTA) and Transcranial Doppler (TCD) indicated subtotal resection of tumor and bypass patency.

**Outcomes:** The patient was discharged with the right limbs of muscle strength of grade IV. The muscle strength of the patient returned to grade V after 6 months of follow-up.

**Lessons:** Comprehensive treatment of tumor resection and extracranial-intracranial bypass concerning medial sphenoid ridge meningioma associated with severe stenosis of the internal carotid artery of intracranial segments is effective.

**Abbreviations:** CT = computed tomography, CTA = computed tomography angiography, DC = decompressive craniectomy, DSA = digital subtraction angiography, ICA = internal carotid artery, MCA = middle cerebral artery bypass, MRI = magnetic resonance imaging, STA = superficial temporal artery, TCD = transcranial Doppler.

**Keywords:** extracranial–intracranial bypass, internal carotid artery stenosis, sphenoid ridge meningioma

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*Ethical approval:* The study was approved by the ethics committee of First affiliated Hospital of Soochow University. The patient had the informed consent concerning the operation and the study.

The authors have no conflicts of interest to disclose.

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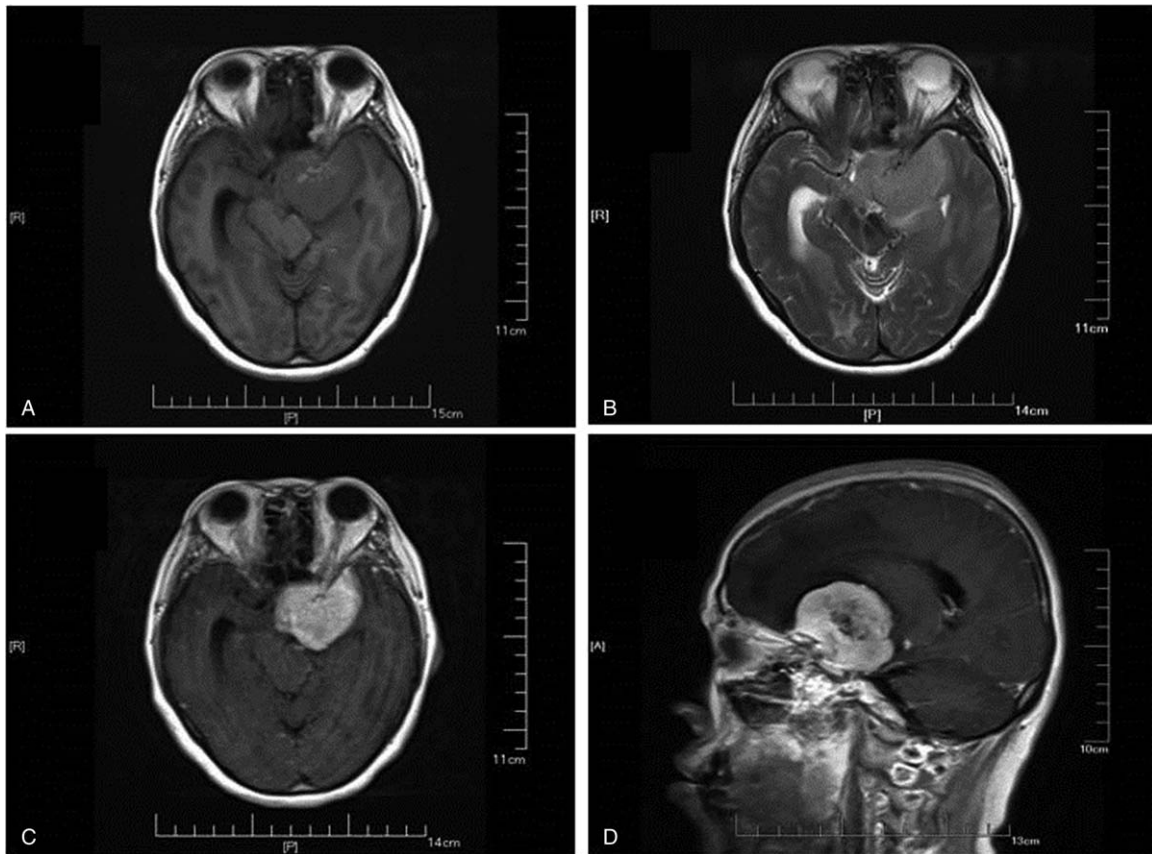
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## 1. Introduction

Medial sphenoid ridge meningiomas are one of the most common skull base tumors. However, this kind of lesions invading intracranial segments of ICA are challenging as to tumor resection and ischemic events. Extracranial–intracranial bypass has been commonly utilized in the process of treating Moyamoya disease, giant fusiform aneurysms and other ischemic cerebrovascular diseases.<sup>[1–3]</sup> However, it is rarely studied that which method can be used to deal with sphenoid ridge meningioma associated with severe stenosis of the intracranial segments of the internal carotid artery (ICA). Tumor resection and prevention of ischemic stroke owing to severe stenosis of the ICA invaded by tumor should be taken into consideration simultaneously. The former may exacerbate the latter.<sup>[4,5]</sup> Severe ischemia may happen. So the complicated neurosurgical lesions should be paid more attention. We present a case of medial sphenoid ridge meningioma associated with severe stenosis of the intracranial segments of the ICA. Tumor resection and extracranial–intracranial bypass were carried out



**Figure 1.** Preoperative MRI scans shown lesions on the left medial sphenoid ridge.

simultaneously. To the best of our knowledge, this is rare case that severe stenosis of the ICA of intracranial segments invaded by sphenoid ridge meningioma achieve no-destructive protection following tumor resection.

## 2. Case description

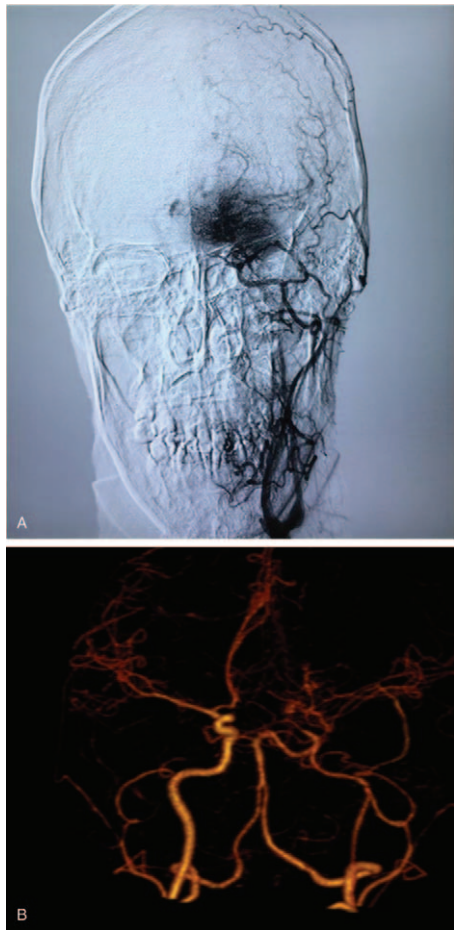
A 63-year-old female was admitted to our hospital with headache and eyesight weakness for 6 months. 0.4 left, 1.0 right eyes were found in the visual acuity. The muscle strength of the patient was in grade V. Simultaneously, the patient suffered hyperthyroidism, mirror-image dextrocardia, and congenital heart disease atrial septal defect. Preoperative imaging CT, CTA, and magnetic resonance imaging (MRI) shown a mass located on the left sphenoid ridge and invaded the intracranial segments of the ICA (Fig. 1). What's more, the invasion led to severe stenosis of the left ICA (Fig. 2).

Because of poorly general conditions of the female, the colleagues of department of cardiac surgery, anesthesiology, and respiratory medicine agreed on our plan of resecting the tumor following the comprehensive evaluation. In addition, our colleagues of department of anesthesiology suggested that microinterceptor monitoring should be used to monitor cardiac index and the less amount of fluid infusion may be considered to reduce the possibility of pulmonary hypertension. We followed the critical advice. For reducing the blood loss intraoperatively, we were eager to perform super selective embolization in supplying vessels of tumor. However, the interventional branch performed DSA and found collateral circulation between the

supplying vessels of left middle meningeal arteries and anterior choroid arteries (Fig. 3). No embolization was determined considering the risk of cerebral ischemia.

The surgical steps were as follows. We designed the scalp incision for protecting the collateral circulation between the left middle meningeal arteries and anterior choroid arteries. The patient underwent the left frontotemporal craniotomy. First, we carried out subtotal resection of medial sphenoid ridge meningioma (Fig. 4). Second, the end-to-side anastomosis of frontal branch of the left superficial temporal artery (STA) to M2 of middle cerebral artery bypass (extracranial-intracranial bypass) was done. Transcranial Doppler (TCD) indicated bypass patency of STA-MCA (Fig. 5). Additionally, ipsilateral decompressive craniectomy was done (Fig. 6). The patient underwent close monitoring in neurosurgical intensive care unit following the bypass and no adverse events occurred. Plavix (75 mg/day) and Aspirin (100 mg/day) were administrated simultaneously. The postoperative imaging computed tomography (CT), computed tomography angiography (CTA), and TCD indicated subtotal resection of tumor and bypass patency (Fig. 7). And pathological findings proved meningioma (Fig. 8). The patient was discharged 10 days following the operation with the right limbs of muscle strength in grade IV. The postoperative visual acuity of the patient was similar to that of the preoperative one. The muscle strength of the patient returned to grade V after 6 months follow-up.

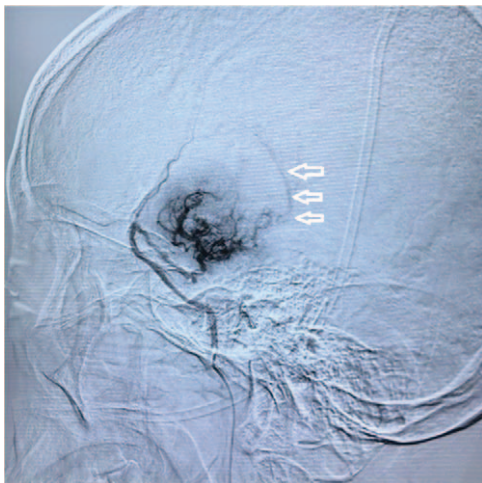
The study was approved by the ethics committee of the First affiliated Hospital of Soochow University. And it was also consented by the patient.



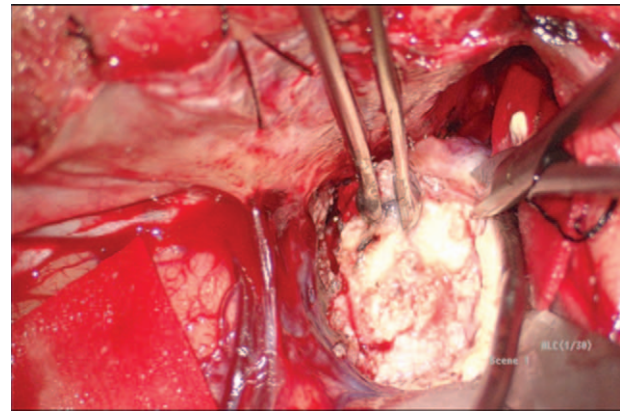
**Figure 2.** Preoperative DSA (A) and CTA (B) scans shown the disappearance of the left ICA of intracranial segments and severe stenosis of the left middle cerebral artery.

### 3. Discussion

Medial sphenoid ridge meningiomas associated with invading the intracranial segments of the ICA are complicated intracranial lesions. Tumor resection and prevention of ischemic stroke owing



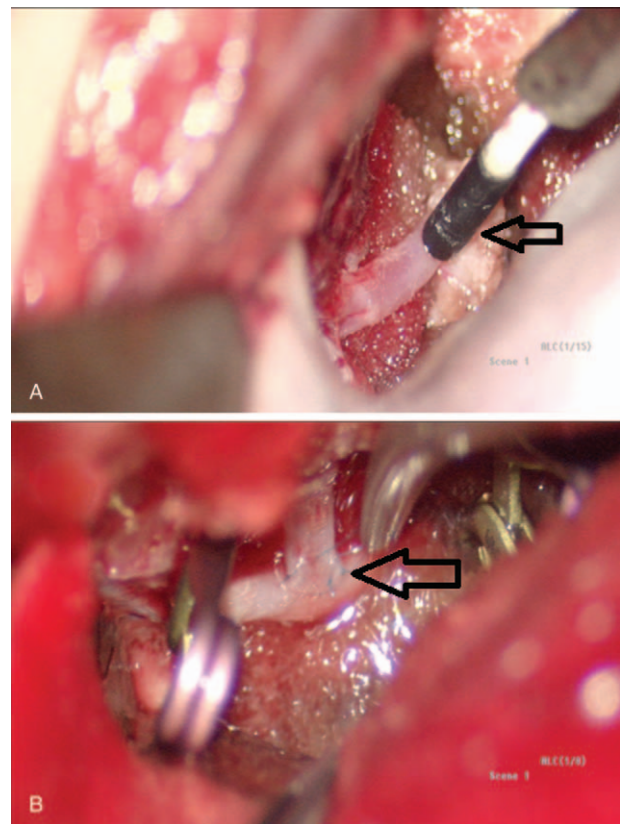
**Figure 3.** DSA indicated collateral circulation (arrows) between the supplying vessels of left middle meningeal arteries and the left anterior choroid arteries.



**Figure 4.** Resection of the left medial sphenoid ridge meningioma.

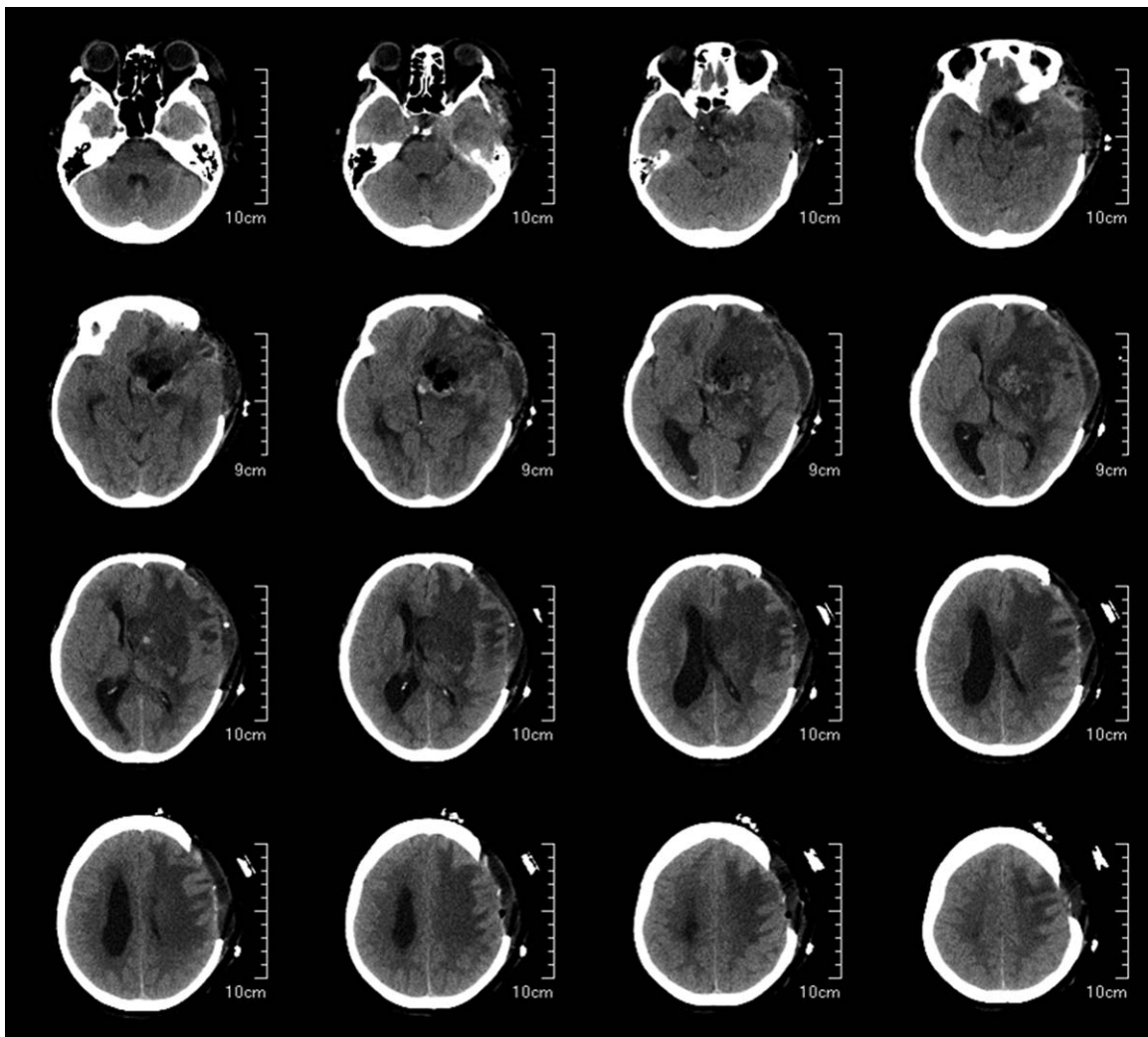
to severe stenosis of the ICA invaded by tumor are indispensable. Although the rate of ischemic events caused by meningiomas was very low, the results could be disastrous.<sup>[5]</sup>

Extracranial–intracranial bypass, especially STA-MCA bypass, is regarded as an effective cerebral revascularization.<sup>[3,4]</sup> However, in 2011, previous studies concerning EC-IC bypass, especially the randomized trial of the carotid occlusion,<sup>[6]</sup> shown us negative effect. Even hemorrhage caused by reperfusion following the revascularization was not ignored.<sup>[7]</sup> Of course, in 2016, Ma et al<sup>[8]</sup> indicated that the results of the randomized trial may be defective and controversial. However, our team insist that



**Figure 5.** TCD (arrow) examined the blood flow of the left middle cerebral artery (M2) (A). The end-to-side anastomosis (arrow) of frontal branch of the left superficial temporal artery to the left middle cerebral artery (M2) bypass (B).





**Figure 6.** The left frontotemporal decompressive craniectomy was done following bypass.

for improving the cerebral perfusion, EC-IC bypass can be an effective method in ischemic stroke in patients with carotid occlusion. So in order to decrease the rate of intracranial hemorrhage caused by reperfusion following the revascularization, we perform the procedure in selective patients.

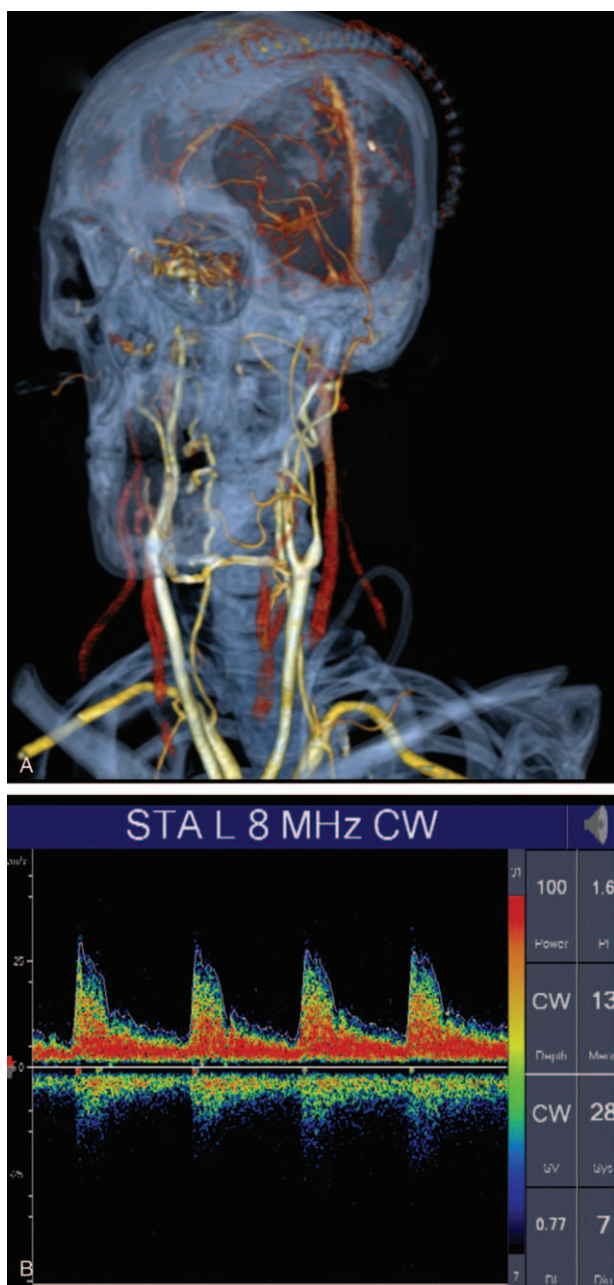
Combined treatment consisting of super selective embolization in supplying vessels, EC-IC bypass and tumor resection are taken into consideration. Effective embolization has advantages, such as minimizing the loss of blood, making the tumor softer and shortening time of operation, but the controversial aspect deserves careful consideration.<sup>[9,10]</sup> However, selective embolization may lead to severe stroke. In the patient, the DSA scans indicated collateral circulation between the supplying vessels of left middle meningeal arteries and anterior choroid arteries.

Collateral circulation is vital to patient with combined skull base tumors and ICA occlusion.<sup>[1,4]</sup> Traditional embolization may destroy the fragile collateral circulation. In order to minimize the iatrogenic injuries, we paid attention to the supplying vessels of left middle meningeal arteries and meningeal incision in the process of craniotomy. Frankly, the above factors increased the difficulty of removing the tumor. Even some researches only achieved partial resection because of the severe bleeding.<sup>[3]</sup> In addition, before intracranial revascularization concerning skull base tumors, the

balloon test occlusion (BTO) should be performed. However, compared with vascular lesions, the BTO concerning skull base tumors can obtain lower reliability, and the EC-IC bypass should be done for preventing ischemic event in the process of safe removal of skull base tumors.<sup>[11]</sup> As an invasive technique, EC-IC bypass should be performed in selective patients. The selective patients have proper collateral circulation, good supplying vessels, and recipient vessels. Concerning the poor health conditions, the mirror-image dextrocardia and congenital heart disease atrial septal defect, we carried out the EC-IC bypass for preventing ischemic event in the left cerebral hemisphere following the resection of sphenoid ridge meningioma.

#### 4. Conclusions

Comprehensive treatment of tumor resection and extracranial-intracranial bypass concerning medial sphenoid ridge meningioma associated with severe stenosis of the intracranial segments of the ICA is effective. Preoperatively, comprehensive evaluation of collateral anastomosis between the ICA and external carotid artery should be paid more attention. To elucidate the surgical treatment, further studies are necessary as to the complicated disease because of limited cases.

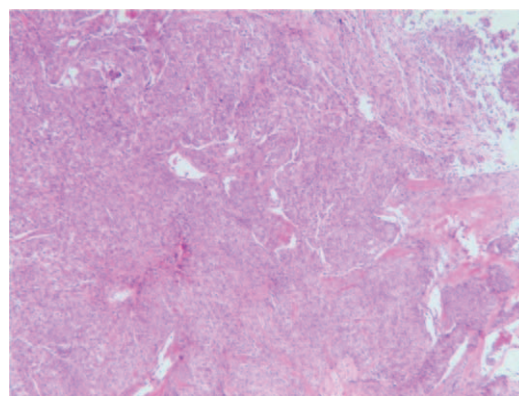


**Figure 7.** Postoperative CTA (A) and TCD (B) scans indicated the patency of anastomosis of frontal branch of the left superficial temporal artery to M2 of middle cerebral artery bypass.

### Author contributions

**Data curation:** Qingdong Han.

**Investigation:** Zhong Wang, Qingdong Han.



**Figure 8.** Pathological findings proved meningioma on the left medial sphenoid ridge.

**Supervision:** Qingdong Han.

**Writing – original draft:** Yabo Huang.

**Writing – review & editing:** Qingdong Han.

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