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Fully Endoscope-Controlled Clipping Bilateral Middle Cerebral Artery Aneurysm Via Unilateral Supraorbital Keyhole Approach

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METHODS

Abstract: Clipping bilateral middle cerebral artery (bMCA) aneurysms via unilateral approach in a single-stage operation is considered as a challenge procedure. To our knowledge, there is no study in surgical management of patients with bMCA aneurysms by fully endoscope-controlled techniques. The author reported a patient with bMCA aneurysms who underwent aneurysms clipping via a unilateral supraorbital keyhole approach by endoscope-controlled microneurosurgery, and the patient had an uneventful postoperative course without neurologic impairment and complication. Furthermore, the author discussed the advantages and adaptation of endoscope-controlled clipping bMCA aneurysms via unilateral supraorbital keyhole approach.

Key Words: Bilateral middle cerebral artery aneurysms, endoscope-controlled microneurosurgery, supraorbital keyhole approach

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The incidence of bilateral middle cerebral artery (bMCA) aneurysms has been reported approximately 1% of all intracranial aneurysms.^{1–3} Surgical management of bMCA aneurysms is still controversial and considered a challenge procedure for neurosurgeons, although clipping all aneurysms in a single-stage operation is more preferred^{2,4–6,7,8} to eliminate bleeding from unruptured aneurysm in perioperative period.^{6,9,10,11} Despite the fact that unilateral management of bMCA aneurysms has been addressed in a few publications,^{4,12–14} only one publication describes microscopy-assisted clipping of bMCA aneurysms via a unilateral supraorbital keyhole approach.¹³ To our knowledge, there is no study in surgical management of patients with bMCA aneurysms by fully endoscope-controlled techniques. In this study we describe 1 patient with bMCA aneurysms who underwent aneurysm clipping via a unilateral supraorbital keyhole approach by endoscope-controlled techniques.

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Patient

A previously healthy 62-year-old male presented with a 9-day history of severe headache and vomiting. On admission, his neurologic examination was normal, except for a stiff neck. The patient was judged clinically to be Hunt and Hess grade I. The brain computed tomography (CT) revealed subarachnoid hemorrhage (SAH) prominently occupying the right sylvian fissure and supra-sellar cisterns. Cerebral Angio-CT revealed 2 aneurysms arising from the bMCA bifurcations (Fig. 1A). The CT and Angio-CT findings indicated that the right MCA aneurysm was probably responsible for the SAH. A decision of clipping aneurysms was made to operate the patient.

Operation Procedure

A standard right supraorbital keyhole approach with small posterior extension for frontobasal lateral burr hole is used for bMCA aneurysm clipping. The patient is positioned supine, and the head fixed in a Mayfield frame is slightly titled backward and rotated 20° away from the right side. Mannitol is administered at the start of the operation for brain relaxation. An approximately 5-cm skin incision was made in the upper half of right eyebrow starting from the midpupillary line to behind the frontal process of the zygomatic bone. The temporalis muscle was cut approximately 1.5 cm in the lateral part of the incision, and exposed for a frontobasal lateral burr hole posterior to the temporal line. The minicraniotomy (approximately 3 × 3 cm) is performed in the frontal bone. The dura is then opened in a curved fashion with its base toward the roof of orbital providing a 2.5 cm opening. With the use of a narrow brain spatula, the right frontal lobe was gently retracted. To avoid frontal lobe contusion spatula creeping technique was adopted until the optic nerve, chiasmatic, lamina terminalis, and internal carotid artery (ICA) nerve are encountered, at which point the cisterns are opened to achieve brain relaxation and frontal lobe retraction. The 30° endoscope was then placed along the bottom of frontal lobe, and fixed by a holding device allowing bimanual manipulation during the surgical procedure. Subsequently, arachnoid attachments between the frontal lobe and olfactory nerve are dissected to avoid postoperative anosmia. After the right ICA and sylvian cisterns are opened, the right ICA bifurcation was identified, and then dissection is continued by following M1 until the right aneurysm was encountered. After careful dissection of aneurysm neck free of adhesions to the surrounding vascular and neural structures, the right aneurysm was clipped (Fig. 2A-B). During this procedure the angle of endoscopy was multiplied adjusted to avoid wrong clipping. Afterward, the endoscopy was adjusted to the left side and anterior communicating artery complex and the left optic nerve was identified, and the dissection is continued to contralateral ICA bifurcation by following the contralateral A1 segment. The left ICA and sylvian cisterns are then opened, and finally the contralateral M1 segment is identified. Dissecting along the M1 from medial to lateral direction, the left aneurysm and

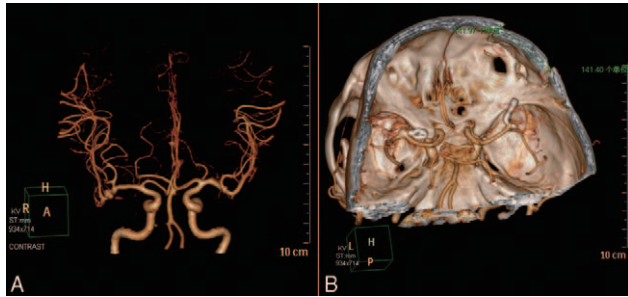


FIGURE 1. Angio-CT of pre- and postoperation: (A) cerebral Angio-CT revealed 2 aneurysms arising from the bMCA bifurcations, and (B) postoperative Angio-CT confirmed good occlusion of the bilateral aneurysms.

the 2 M2 branches were visualized. The aneurysm was clipped without temporal clipping of the M1 (Fig. 2C-F).

Postoperative Management

The patient was admitted to intensive care unit for the first 24 hours after operation. Calcium channel blockers (Nimodipine) had been given at 4 mL per hour via venous pump, and 3H therapy (hypertension, hypervolemia, and hemodilution) was adopted to elevate systolic blood pressure to 150 to 160 mm Hg, to maintain intravenous infusion volume 200 mL per hour, and to keep hematocrit $\leq 35\%$. The patients underwent brain CT examination after anesthetic recovery, and postoperative Angio-CT 5 days after operation.

RESULTS

Surgical procedure was uneventful, and the patient had an excellent postoperative course without neurologic impairment and complication. Postoperative Angio-CT confirmed good occlusion of the bilateral aneurysms (Fig. 1B). The patient was discharged home in good condition 2 weeks later.

DISCUSSION

Cerebral aneurysms occur with an incidence of 1/10,000 per year. Approximately 7% to 34% of the patients harbor multiple intracranial aneurysms, and the aneurysms are bilateral in 20% to 40% of these patients.^{15,16} The incidence of bMCA aneurysms aneurysms has been reported approximately 1% of all intracranial aneurysms.¹⁻³ Middle cerebral artery aneurysms are generally not suitable for endovascular treatment, due to their often complex configuration and/or broad neck. Therefore, surgical treatment is still the first choice in many patients with MCA aneurysms. The bilateral craniotomies are traditional therapies to clip those aneurysms. The contralateral approach can be considered as a useful procedure to clip bMCA aneurysms; its use is not widely spread because of technical difficulty, the long dissecting distance, limiting view, and impaired the brain tissue. Oshiro et al¹⁴ previously described the contralateral exposure for the most common sites of anterior circulation aneurysms. Several authors have reported clipping of bilateral aneurysms via unilateral craniotomy successfully in case series and clinical reports.^{12,15,16}

Surgical management of bMCA aneurysms is still controversial and considered a challenge procedure, although clipping all aneurysms in a single-stage operation is more preferred.^{2,4-6,7,8} The unilateral approach presents some important advantages comparing 1- or 2-stage operations: avoiding a second craniotomy, shorter operation time, shorter hospitalization, reducing the cost of treatment, and less cosmetic defect due to single craniotomy. In addition, the most important advantage of 1-stage operation is

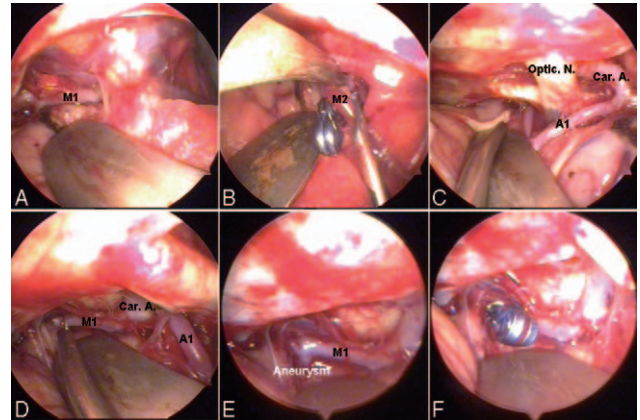


FIGURE 2. The procedure of clipping bMCA aneurysms: (A) intraoperative picture of the right sylvian cisterns dissection, (B) intraoperative picture of clipping the right aneurysm, (C, D) contralateral progression of the dissection the left ICA bifurcation and sylvian fissure, (E) intraoperative picture of left aneurysm, and (F) intraoperative picture of clipping the right aneurysm. A1, anterior cerebral artery; Car. A., internal carotid; M1, 2, middle cerebral artery segment M1, 2; Optic. N., optic nerve.

elimination of the risk of rebleeding from unrupture aneurysms, due to 3H treatment for vasospasm may carry a potential risk of rupturing an untreated aneurysm in the postoperative period.¹⁷

The recent keyhole approaches have been made possible by technological advances such as by three-dimensional CT angiography guidance, by the use of endoscopes, and by the manufacturing of dedicated microsurgical instruments. The supraorbital keyhole approach is a minimally invasive approach, and both the ipsilateral and contralateral MCA aneurysms can be approached from proximal to distal. The side of approach was preferentially chosen as the side of the suspected bleeding source in all patients with SAH, in patients without SAH it was based on morphologic characteristics but not on speech dominance.¹³ Factors for successful clipping of the contralateral aneurysm are as follows: the severity of cerebral edema, total length of the contralateral (A1+M1) segments, configuration of the contralateral aneurysm, contralateral ICA bifurcation angle, and projection of the contralateral aneurysm.¹⁸

Compared with microscope in bMCA aneurysms clipping via supraorbital keyhole approach, with the endoscope better visualization and ability to operate freely on the contralateral anterior cerebral artery, ICA, M1, and origin of M2 were achieved. The direction of the contralateral aneurysm is very important during bMCA aneurysms clipping surgery via supraorbital keyhole approach. Aneurysms pointing inferior are more difficult to clip from the contralateral approach because the MCA regularly covers the neck region of the aneurysm and visualization of the perforating branches is poor. Aneurysms pointing in lateral, anterior, or posterior directions are also more difficult to clip from the contralateral side because further inferior extension of the neck may be difficult to recognize. In these situations endoscope-controlled microneurosurgery help to enhance the pathoanatomic situation.¹³ Endoscope-controlled techniques have the following advantages: deep surgical field brightness can be increased and allow pathologic anatomy in a short distance to extend view angle and a clear descriptive. According to surgical need to change the depth the angle of the endoscope, and a different perspective of the endoscope can increase vision information, so as to achieve complete clipping the aneurysm, to avoid the occurrence of mistaken clipping.

Fully endoscope-controlled clipping intracranial aneurysms were rarely reported.¹⁹ In this study, we reported a case of bMCA aneurysms endoscope-controlled clipping via unilateral

supraorbital keyhole craniotomy. We believed that fully endoscope-controlled clipping bMCA aneurysms was a practically feasible method, which combined advantages of both unilateral supraorbital keyhole approaches and endoscopic technology. Because of the limited operative space and relative deep location, the surgery should be performed by experienced neurosurgeons. Fully endoscope-controlled clipping bMCA aneurysms may be a safe and effective application to increase the quality of treatment.

REFERENCES

1. McMahon JH, Morgan MK, Dexter MA. The surgical management of contralateral anterior circulation intracranial aneurysms. *J Clin Neurosci* 2001;8:319–324
2. Santana Pereira RS, Casulari LA. Surgical treatment of bilateral multiple intracranial aneurysms. Review of a personal experience in 69 cases. *J Neurosurg Sci* 2006;50:1–8
3. Shin BG, Kim JS, Hong SC. Single-stage operation for bilateral middle cerebral artery aneurysms. *Acta Neurochir (Wien)* 2005;147:33–38
4. de Oliveira E, Tedeschi H, Siqueira MG, et al. Anatomical and technical aspects of the contralateral approach for multiple aneurysms. *Acta Neurochir (Wien)* 1996;138:1–11
5. Mizoi K, Suzuki J, Yoshimoto T. Surgical treatment of multiple aneurysms. Review of experience with 372 cases. *Acta Neurochir (Wien)* 1989;96:8–14
6. Orz Y, Osawa M, Tanaka Y, et al. Surgical outcome for multiple intracranial aneurysms. *Acta Neurochir (Wien)* 1996;138:411–417
7. Vajda J, Juhasz J, Orosz E, et al. Surgical treatment of multiple intracranial aneurysms. *Acta Neurochir (Wien)* 1986;82:14–23
8. Vajda J, Juhasz J, Pasztor E, et al. Contralateral approach to bilateral and ophthalmic aneurysms. *Neurosurgery* 1988;22:662–668
9. Cervoni L, Delfini R, Santoro A, et al. Multiple intracranial aneurysms: surgical treatment and outcome. *Acta Neurochir (Wien)* 1993;124:66–70
10. Hashimoto Y, Horita Y, Imaizumi T, et al. Postoperative rupture of an untreated aneurysm on the 3rd day after subarachnoid hemorrhage surgery. *Neurol Med Chir (Tokyo)* 2005;45:249–252
11. Vajda J. Multiple intracranial aneurysms: a high risk condition. *Acta Neurochir (Wien)* 1992;118:59–75
12. de Sousa AA, Filho MA, Faglioni W, et al. Unilateral pterional approach to bilateral aneurysms of the middle cerebral artery. *Surg Neurol* 2005;63(suppl 1):S1–S7
13. Hopf NJ, Stadie A, Reisch R. Surgical management of bilateral middle cerebral artery aneurysms via a unilateral supraorbital key-hole craniotomy. *Minim Invasive Neurosurg* 2009;52:126–131
14. Oshiro EM, Rini DA, Tamargo RJ. Contralateral approaches to bilateral cerebral aneurysms: a microsurgical anatomical study. *J Neurosurg* 1997;87:163–169
15. Rajesh A, Praveen A, Purohit AK, et al. Unilateral craniotomy for bilateral cerebral aneurysms. *J Clin Neurosci* 2009;17:1294–1297
16. Rodriguez-Hernandez A, Gabarros A, Lawton MT. Contralateral clipping of middle cerebral artery aneurysms: rationale, indications, and surgical technique. *Neurosurgery* 2012;71(1 suppl Operative):116–123
17. Solander S, Ulhoa A, Vinuela F, et al. Endovascular treatment of multiple intracranial aneurysms by using Guglielmi detachable coils. *J Neurosurg* 1999;90:857–864
18. Inci S, Akbay A, Ozgen T. Bilateral middle cerebral artery aneurysms: a comparative study of unilateral and bilateral approaches. *Neurosurg Rev* 2012;35:505–517
19. Fischer G, Oertel J, Pernecky A. Endoscopy in aneurysm surgery. *Neurosurgery* 2012;70(2 suppl Operative):184–190