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Case Report

Contralateral Transcondylar Fossa Approach with Bilateral V3 Segment Exposure for Clipping of Vertebral Artery Aneurysm Which Deviates Across Midline: A Case Report and Review Article

Abstract

This article reports a patient with unruptured right vertebral artery aneurysm which deviates across the midline to the left side. The contralateral (left) transcondylar fossa approach with bilateral V3 exposure is used for aneurysm clipping. The literature related to this technique is also reviewed.

Keywords: *Bilateral V3 exposure, transcondylar fossa approach, vertebral artery aneurysm*

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Introduction

The transcondylar fossa approach, which is a variant of the far lateral approach,[1] was first reported in 1996 by Matsushima *et al*.[2-4] as the surgical approach for vertebral artery (VA) aneurysm[5] and ventral foramen magnum meningioma.[6]

Contralateral approach for the treatment of VA aneurysm was reported in four papers.[7-11] In all cases, the authors noted that the decision to approach from the contralateral side was based on the tortuosity of the VA. In this report, we describe a patient with unruptured right VA aneurysm which deviated across the midline to the left side and which was treated with contralateral (left) transcondylar fossa approach with bilateral V3 segment exposure. The literature about these surgical techniques was reviewed.

Case Report

A 65-year-old man with a 2-month history of the right transsylvian approach to clip a ruptured right internal carotid-posterior communicating artery aneurysm with a 5-mm unruptured wide-neck saccular aneurysm at V4 segment of the right VA [Figure 1]. The right VA aneurysm deviated across the midline to the left lower 1/3 of the clivus, level with the hypoglossal canal, and projected to the left side [Figure 1b and c]. The patient had neither other symptoms nor any underlying disease.

The indications for surgery in this patient were posterior circulation aneurysm and history of previous subarachnoid hemorrhage.[12] The contralateral (left side) transcondylar fossa approach and exposure of V3 segment of the right VA were selected for aneurysm clipping due to the accessibility to the aneurysm and the safe proximal control.

The patient was placed in the right semi-prone park-bench position (the left side up) under general anesthesia [Figure 2a], as same as the position for occipital artery-posterior inferior cerebellar artery (PICA) bypass,[13] but the difference was the location of head pins which were necessary to avoid the right mastoid area [Figure 2b]. A large reversed "L" shape skin incision started from 3 to 4 cm below the left mastoid tip, extended along the left mastoid groove, and then curved 1 cm above the superior nuchal line to the right asterion [Figure 2b]. The suboccipital muscles were dissected in a multiple layer technique to expose the left V3 segment, posterior arch of C1 and the right V3 segment, respectively [Figure 2c]. The left posterior condylar emissary vein was coagulated and excised from the vertebral venous plexus then the posterior condylar canal and the condylar fossa were identified.

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The left transcondylar fossa approach was performed by the following steps. First, the retrosigmoid craniotomy was made, and the bony exposure was extended to transverse and sigmoid sinus [Figure 3a]. The dura was peeled from the foramen magnum and the inferior part of the sigmoid sinus; then, the foramen magnum was removed. The sigmoid–magnum triangle, which was the landmark of the posterior portion of jugular tubercle, was exposed after peeling the dura from the inferior part of the sigmoid sinus. After drilling of the sigmoid–magnum triangle using 3–4 mm extra-coarse diamond burr, the blue line of the hypoglossal canal was identified [Figures 2d and 3b,c]. The dura was opened in a curved shape from the transverse-sigmoid junction to the dura of the foramen magnum [Figures 2e and 4a].

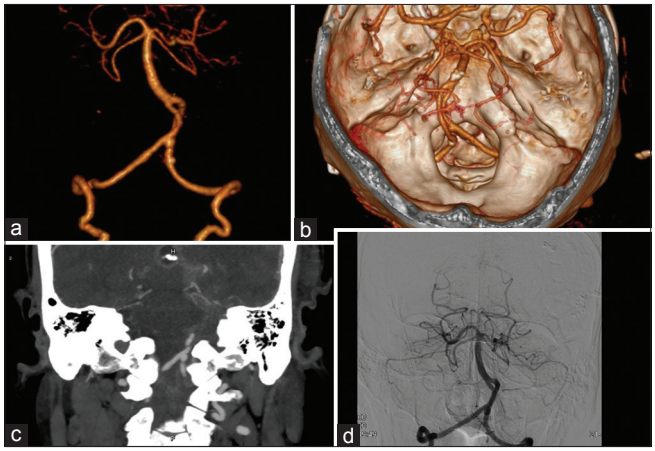

Figure 1: Preoperative images. (a) Preoperative computed tomography angiography showed a wide-neck saccular aneurysm in the right vertebral artery. (b and c) The aneurysm deviated across midline to the left side of lower clivus at the level of hypoglossal canal. (d) Digital subtraction angiography of the right vertebral artery showing the aneurysm

After the dura was opened, cerebrospinal fluid (CSF) was released from cisterna magna. The cerebellum was retracted superomedially. Cranial nerves 9, 10, 11, 12 and left VA were identified [Figure 4a]. The aneurysm on the right VA was found anterior to the left VA, the short segment of right VA proximal to the aneurysm was identified [Figure 4b]. A temporary clip was applied to the proximal right VA with difficulty and after the temporary clip placement, the clip obscured the aneurysm dome [Figure 4c]. Therefore, the temporary clip was remove and the proximal control was changed to be performed at right V3 segment extradurally with bulldog clamp [Figure 4d]. After the distal right, VA was controlled with temporary clip, the aneurysm neck clipping was performed with a right angle fenestrated clip and a standard curved clip for residual proximal aneurysm neck [Figure 4e and f]. Micro-Doppler was used to confirm blood flow of the right VA after the removal of the distal and proximal controls. The dura was closed with watertight technique. The suboccipital muscles were sutured in layer-by-layer fashion. A low-pressure drain was placed above the muscle. The skin was closed in routine fashion.

The patient's postoperative course was uneventful; he was alert without any motor and sensory deficits. Mild dysphagia occurred on postoperative day 1–3. After the low-pressure drain was taken off, a subgaleal collection and inflammation were found. A spinal drain was inserted for 7 days. CSF profile showed bacterial meningitis. After

Figure 2: Position, skin incision, and surgical exposure. (a) Right semi-prone park bench position. (b) Position of head pins and skin incision in large inverted "L" shape. (c) Suboccipital muscle dissection to expose both V3 segments. (d) Left transcondylar fossa approach. (e) Surgical exposure after dura opening and permanent clip placement. C1 – Posterior arch of C1, FM – Foramen magnum, Lt – Left, MG – Mastoid groove, MT – Mastoid tip, Rt – Right, SNL – Superior nuchal line, SS – Sigmoid sinus, TS – Transverse sinus, V3 – V3 segment of vertebral artery

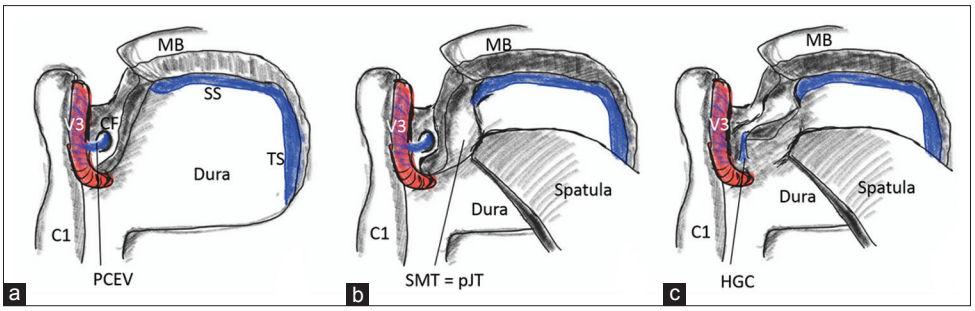

Figure 3: Schema of the left transcondylar fossa approach. (a) Left retrosigmoid craniotomy and sigmoid sinus, transverse sinus, V3 segment of left vertebral artery and posterior condylar emissary vein exposure. (b) Peeling off the dura from the sigmoid–magnum triangle. (c) After drilling of sigmoid–magnum triangle (posterior part of jugular tubercle), the hypoglossal canal was exposed. C1 – Posterior arch of C1, CF – Condylar fossa, HGC – Hypoglossal canal, MB – Mastoid body, PCEF – Posterior condylar emissary vein, pJT – Posterior part of jugular tubercle, SMT – Sigmoid–magnum triangle, SS – Sigmoid sinus, V3 – V3 segment of vertebral artery

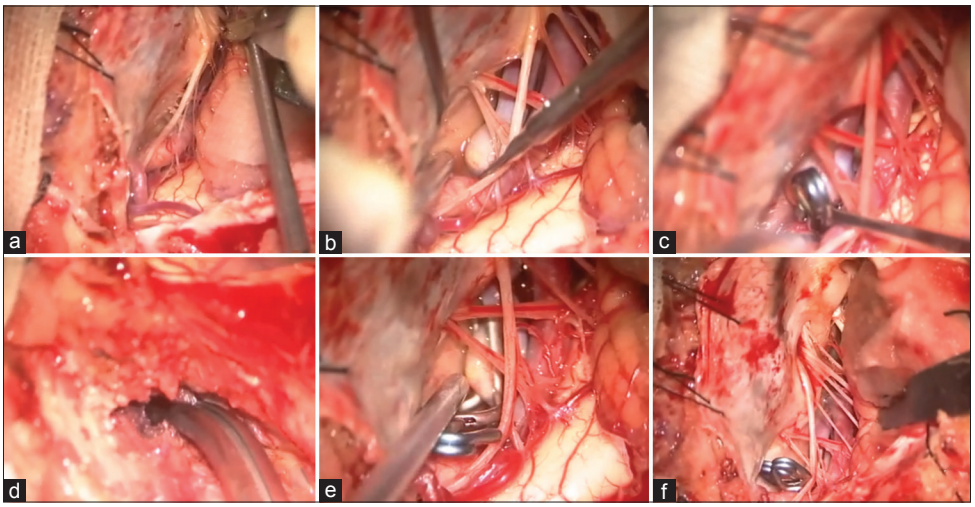

Figure 4: Intraoperative findings and aneurysm clipping. (a) After the dura was opened, lower cranial nerves were skeletonized. (b) The saccular aneurysm of the right vertebral artery was identified below hypoglossal nerve and anterior to the left vertebral artery. (c) The temporary clip at proximal right vertebral artery obscured the aneurysm dome. (d) Bulldog clamping at V3 segment of the right vertebral artery. (e and f) After permanent clipping

14 days of intravenous high-dose antibiotics, the patient was discharged with a Glasgow Outcome Score of 15.

Postoperative computed tomography angiography showed complete obliteration of the aneurysm and good patency of the right VA [Figure 5].

Discussion and Review Article

This patient had an unruptured right VA aneurysm which deviated across the midline to the left side at the level of the hypoglossal canal. If either the right transcondylar approach or transcondylar approach had been used, the advantage of the right-sided approach would have been the proximal control of the aneurysm, but access to the aneurysm was difficult. If the left-sided approach had been selected, access to the lesion would have been easier but proximal control, which was very important when intraoperative rupture occurred, became difficult. Therefore, the best surgical strategy was the left-sided approach with the exposure of the right extracranial VA (V3 segment) for proximal control. The authors followed the surgical technique of Professor Rokuya Tanikawa as reported by Ota *et al*.[11] in 2017.

The far lateral approach is the posterolateral skull base approach to the foramen magnum which is widely used for VA aneurysm[14] and ventral foramen magnum meningioma.[15] This approach was first reported by Heros in 1986[1] for the treatment of VA and vertebrobasilar artery aneurysm.

For variations of the far lateral approach, Rhoton[16] classified three variants as follows: (1) transcondylar approach, with access through the occipital condyle; (2) supracondylar approach, with access above the occipital condyle; and (3) paracondylar approach, with lateral access to the occipital condyle.

The other classification of the far lateral approach is based on the removal of the occipital condyle.[14] If the occipital condyle is removed, it is called transcondylar approach. In cases in which the occipital condyle is preserved, it is called supracondylar approach.[5] In 1996, Matsushima *et al*. modified the supracondylar approach to

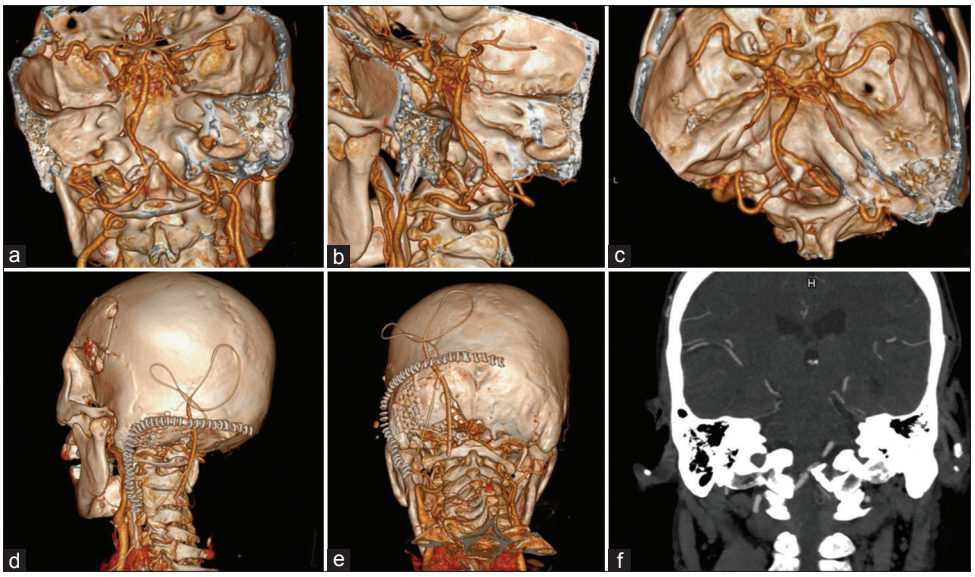

Figure 5: Postoperative computed tomography angiography. (a-c) Three-dimensional reconstruction of computed tomography angiography showed the position of the aneurysm clip, complete obliteration of the aneurysm and good patency of the right vertebral artery. (d and e) The skin stapler showed the line of the skin incision. (f) The coronal view of computed tomography angiography showed the position of the aneurysm clip and patency of the right vertebral artery

the supracondylar transjugular tubercle approach, which is also known as the "transcondylar fossa approach." The key to this approach is the removal of the posterior part of the jugular tubercle which is the main obstacle while taking a lateral approach to the VA, vertebrobasilar artery, and lower clivus with preservation of occipital condyle.[3,5] They described the triangular-shaped bone at the condylar fossa after the removal of the posterior part of foramen magnum between sigmoid sinus and foramen magnum which is the posterior part of the jugular tubercle called "sigmoid–magnum triangle" [Figure 6a]. This part needs to be removed by drilling until the blue line of the hypoglossal canal is exposed.[4,5] The bone below the blue line which is the occipital condyle should be preserved [Figure 6b]. Before access to the condylar fossa and during the removal of jugular tubercle, the posterior condylar emissary vein, which often connects to the sigmoid sinus or jugular bulb through the posterior condylar canal, will be skeletonized, coagulated, and cut and then pushed into the canal.[17]

The transcondylar and transcondylar fossa approaches are the posterolateral skull base approaches for lesions of VA and ventral foramen magnum. The difference between these two approaches is the removal of the occipital condyle which increases the risk atlantooccipital instability. Matsushima *et al*. proposed the indication for these approaches depends on the location of the lesion related to the level of hypoglossal canal: the transcondylar fossa approach (remove the jugular tubercle only, preserve occipital condyle) is indicated for lesions located above the hypoglossal canal and the transcondylar approach (remove posterior part of the jugular tubercle and posteromedial part of occipital condyle) is indicated for those located below it.[5]

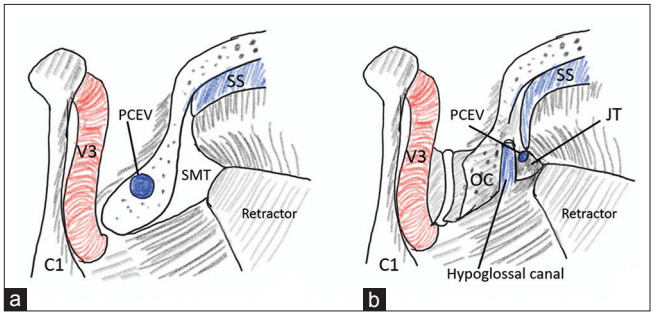

Figure 6: Schema of left transcondylar fossa approach (modified from Matsushima *et al*.[4]). (a) Sigmoid–magnum triangle. (b) After drilling of sigmoid–magnum triangle, hypoglossal canal was exposed. C1 – Posterior arch of C1, JT – Jugular tubercle, OC – Occipital condyle, PCEV – Posterior condylar emissary vein, SS – Sigmoid sinus

There are five reports about the contralateral far lateral approach for the treatment of VA aneurysms. Maeda *et al*. reported the neck clipping of a small unruptured VA-PICA aneurysm which deviated across the midline to the contralateral side using a contralateral suboccipital approach.[7] Taguchi *et al*. reported the successful right transcondylar approach for clipping of ruptured left VA-PICA aneurysm which was located across the midline and just above the foramen magnum.[8] Salcman *et al*. described two cases requiring a contralateral suboccipital approach for clipping of VA-PICA aneurysms which crossed the midline.[9] Bragg and Duckworth reported the contralateral far-lateral approach for clipping of a ruptured VA-PICA aneurysm which was located just left of the midline to the contralateral side.[10] Ota *et al*. reported the trapping and aneurysmectomy for complex right VA aneurysm which deviated to the left using the contralateral (left-sided) transcondylar fossa approach with

bilateral V3 exposure.[11] This is the first report about the new technique for the unilateral far lateral approach which provides bilateral V3 segment exposure for proximal control during surgery.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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