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Petrosal Approach for Aneurysms on the Vertebro-basilar Artery Junction and Mid-Basilar Artery : Technical Note

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= Abstract = **The aneurysms located on vertebro-basilar artery junction and mid-basilar artery are not common. These aneurysms may be surgically clipped through a variety of approaches. The suboccipital approach has potential morbidities due to retraction of cerebellum and brain stem. The supratentorial approach may have retraction damage to the temporal lobe and the vein of Labbé.**

Resection of petrous bone in combined approach of supratentorial and infratentorial route has some advantages. There is minimal retraction of cerebellum, brain stem and temporal lobe, preservation of the vein of Labbé and shortening of the operative distance. Thus the petrosal approach may be helpful for the surgery of aneurysms arising around vertebro-basilar artery junction and mid-basilar artery. We have clipped an aneurysm on the vertebro-basilar artery junction and mid-basilar artery with petrosal approach and discuss its usefulness for the approach to aneurysms on vertebro-basilar artery junction and mid-basilar artery.

Key Words : *Aneurysm, Vertebro-basilar artery junction, Mid-basilar artery, Petrosal approach*

INTRODUCTION

Aneurysms arising from the vertebro-basilar artery junction and mid-basilar artery are not common, that area is surrounded by the petroclival junction, the brain stem, and the cranial nerves. So, surgical access would be difficult. Petrosal approach, resection of petrous bone, to petroclival meningioma had maximal exposure of the petroclival region per se, especially when combined with the splitting of the tentorium (Samii et al. 1989).

Petrosal approach may be helpful for surgery of aneurysms in the same region. We report our experience with the petrosal approach for aneurysms on vertebro-basilar artery junction and mid-basilar artery.

CASE PRESENTATION

Case I

This 50-year-old woman was brought to the emergency room with drowsy mentality and vomiting, she opend eye to painful stimulus and

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Fig. 1. Angiogram of left vertebral artery (Antero-posterior view) (A: Case I, B: Case II)

didn't respond to voice, and localized to painful stimulus (Hunt-Hess Grade IV).

Examination: Computerized tomography(CT) showed diffuse subarachnoid hemorrhage with intraventricular hemorrhage (Fisher's group IV). Angiography demonstrated an aneurysm on vertebro-basilar artery junction, which directed to right side (Fig. 1).

Operation and hospital course: The vertebro-basilar artery junction aneurysm was exposed via the right petrosal approach with splitting of the tentorium. The aneurysm arose from the vertebro-basilar artery junction, with the size of 7 mm between 7th & 8th cranial nerve complex and low cranial nerves (Fig. 3). The aneurysm was prematurely ruptured during the aneurysmal neck dissection. The direct aneurysmal neck clipping was done easily with a right angled fenestrated clip and a straight clip. Immediately, she fully recovered, and right sixth cranial nerve palsy and right facial nerve palsy were detected. She had fever and tachypnea on postoperative fourth day. The brain CT showed no abnormal findings, and she was intermittently irritable thereafter.

On the postoperative ninth day, sudden respiratory arrest occurred. Brain CT demonstrated irregular high and low density on right cerebellum and pons. The lesion progressed on follow-up brain CT and the patient died on eighteenth day postoperatively.

Case II

This 51-year old woman experienced severe headaches of sudden onset. Neurologic examination revealed neck stiffness. After the brain CT was taken, she was transfered to Seoul National University Hospital (Hunt-Hess Grade II).

Examination: CT showed a diffused subarachnoid hemorrhage with intraventricular hemorrhage (Fisher's group IV). Angiography demonstrated an aneurysm on the mid-basilar artery, which directed to right side (Fig. 1).

Operation and hospital course: The mid-basilar artery aneurysm was operated via the right petrosal approach. The aneurysm arose from the branching point of the anterior-inferior cerebellar artery, with the size of 6 mm between 6th cranial nerve and 7th & 8th cranial nerve complex (Fig. 3). After a temporary clip was done on the basilar artery trunk, a direct aneurysmal neck clipping was done easily with a 7 mm straight clip. On the postoperative 14th day, she discharged without neurologic deficit.

OPERATIVE TECHNIQUE

Aneurysms of the vertebro-basilar artery junction and mid-basilar artery are approached with the patient in the supine lateral position. The head is turned to the left, inclined toward the floor, and tilted toward the left side, making

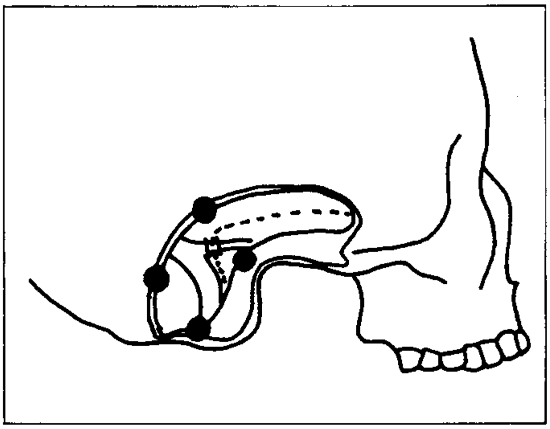

Fig. 2. Position of the burr holes (black circle), outlining the bone flap (right side) and dural incision (broken line)

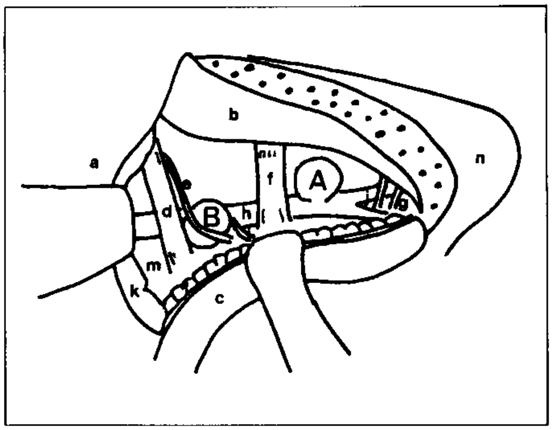

Fig. 3. Operative findings (A: Case I, B: Case II, a: subtemporal dura, b: presigmoid dura, c: sigmoid sinus, d: 5th cranial nerve, e: 6th cranial nerve, f: 7th & 8th cranial nerve, g: low cranial nerve, h: basilar artery, i: anterior-inferior cerebellar artery, j: vertebral artery, k: temporal lobe, l: cerebellum, m: brain stem, n:mastoid bone)

petrous base the highest point of the operative field. A reverse question-mark incision is made, starting at the zygoma in front of the ear, circling above the ear, and descending 1cm medial to the mastoid process. Four burr holes are made, two on each side of the transverse sinus. A key burr hole made just medial and inferior to the asterion opens into the posterior fossa below the transverse-sigmoid sinus junction. The single bone flap is elevated, exposing the transverse and sigmoid sinus (Fig. 2).

Drilling is continued along toward its apex pyramid to thin the petrous bone. The posterior fossa dura anterior to the sigmoid sinus is opened along the sinus, the incision is extended upward a supratentorial dural incision. The superior petrosal sinus is clipped and transected, and the incision is continued on the tentorium, parallel to the pyramid, and extended through the incision.

The supratentorial incision is continued along the floor of the temporal fossa. Once the dural incisions have been completed, the temporal lobe and the cut tentorium are protected by retractors that allow the base of the temporal lobe to be elevated without stretching the vein of Labbé. This maneuver exposes the ipsilateral petrous region, the entire clivus, and the cranial nerves (Fig. 3). The distance between the petrous ridge and the basilar artery is approximately 2.5cm. At closure, the temporal and occipital dura is reapproximated. Abdominal adipose tissue, temporalis muscle and fibrin glue are used to obliterated the temporal bone resection of the exposure. Temporary lumbar spinal drainage for 3 to 5 days is used to control leakage of cerebrospinal fluid.

DISCUSSION

In the past two decades, Drake and Peerless reported reaching aneurysms arising from the mid-and lower basilar artery either from above via the subtemporal-transtentorial route, or from below via a suboccipital craniectomy (Drake 1968; Peerless et al. 1988). When the aneurysm was located at the verbetro-basilar artery junction and mid-basilar artery, it was difficult to expose via either route. Because of the limited space exposing an aneurysm via the subtem-

Fig. 4. Postoperative brain CT (arrow: direction of entry)

poral route, it may be necessary to retract the temporal lobe to see beyond the petrous ridge. Such retraction can damage the bridging veins causing hemorrhagic infarction (Jamieson 1968; Sugita et al. 1979). Retraction damage to the temporal lobe and injury to the vein of Labbé may be lessened by adopting the extradural transpetrosal technique (Kawase et al. 1985). This approach suffers from a relatively constricted corridor (2×1 cm) between the trigeminal nerve and the cochlea as well as a heightened potential for hearing loss and CSF rhinorrhea. The suboccipital approach and its modifications have the benefit of being familiar to most surgeons. However because the rostral extent of the craniectomy is limited by the sigmoid sinus, the line of sight to the lesion is along a caudal to rostral diagonal that significantly lengthens the distance. The necessity to retract both the cerebellum and the brain stem adds to potential morbidity. This risk can be lessened by a more radical removal of the wing the of the foramen magnum and arch of C-1 laterally, but some medullary retraction may still be necessary (Heros 1986). For either the supratentorial or the suboccipital approach requiring a diagonal trajectory, the ability to gain proximal or distal control of the parent vessel (expecially with large aneurysm) may be compromised. Transoral or transclival approach has the narrowness of clivus and the long transverse through the oropharynx with unacceptable potential for CSF leakage and infection, these more than offset the benefits of avoiding retraction damage. Commonly, these supratentorial or suboccipital approaches have two disadvantages. First, retraction of the brain stem and temporal lobe is responsible for a large portion of the morbidity associated with surgery for petroclival region. Second, these approaches are hampered by relatively deep access along constricted corridors.

Kawase et al. (1985) reported that surgical removal of the petrous bone gives the surgeon the possibility of reaching the cerebello-pontine angle and anterolateral portion of the pons with minimum brain retraction, and combined with subtemporal access minimizes the possiblity of damage to bridging vein such as vein of Labbé. Drilling of the petrous bone also gives some benefits. The direction of entry is the shortest trajectory to the middle and lower thirds of the clivus and consequently, the mid-basilar artery and vertebrobasilar junction (Fig. 4). In addition, the dependent portion of the cerebellum in conjunction with spinal drainage and osmotic agents, minimizes cerebellar retraction and eliminates brain stem retraction. The brain stem in effect falls away from the clivus. The petrosal approach exposed the basilar artery from the point where the superior cerebellar artery take off to just proximal to the vertebrobasilar junction. Thus proximal and distal control for a basilar trunk aneurysm is easily achieved (Giannotta et al. 1988).

In summary the petrosal approach has several advantages; 1) the cerebellar and temporal lobe are minimally retracted, 2) operative distance to the vertebro-basilar artery junction is shortened, 3) the surgeon has a direct line of sight to the lesion and the anterior and lateral aspects of the brain stem, 4) otologic structures are preserved, 5) the transverse and sigmoid sinus as well as the vein of Labbé are preserved, 6) proximal control is easy because two parent vertebral arteries are visualized. Of course, the petrosal approach has some complications. As expected, there is a high incidence of cranial nerve deficits from surgical manipulation. Al-mefty et al.(1988) reported cranial nerve deficits in more than 50% of their patients. Facial nerve injury due to surgical manipulation was the most frequent postoperative complication(Spetzler et al. 1992). Others are CSF leaks, decreased gag reflex, abducens nerve paresis etc. At present, surgical time is long and we need consultation to otorrhinologic doctors. Familiarity with mastoid anatomy and neurotological surgical techniques in making the approach, enhances the speed of the procedure. Further experience is necessary to ascertain the advantages and disadvantages of the petrosal aproach.

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