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Surgical Approach to Arteriovenous Malformation of the Medial Temporal Lobe

—Report of Three Cases—

Nobuo OKA, Kazuyo KAMIYAMA, Jun-ichi NAKADA, Shunro ENDO and Akira TAKAKU

Department of Neurosurgery, Toyama Medical and Pharmaceutical University, Toyama

Abstract

We report three cases of arteriovenous malformation (AVM) of the medial temporal lobe and the surgical approaches used. The AVM was fed by the anterior choroidal artery (AChA) in two cases (Cases 1 and 2) and by the posterior cerebral artery in one (Case 3). The trans-Sylvian approach was first used for cerebrospinal fluid aspiration to retract the brain in all cases, and for confirming the feeding arteries to prevent premature bleeding from the AVM in Cases 1 and 2. In Case 1, a corticotomy was then made in the fusiform gyrus *via* the subtemporal approach to avoid the development of speech disturbance and visual field defects, while in Cases 2 and 3, a cortical incision was made in the middle temporal gyrus because visual field defects were preoperatively present. Cases 1 and 2 achieved good recoveries, but Case 3 suffered postoperative speech disturbance and died of rebleeding from a recurrent AVM fed by the AChA 22 months after the operation. This AVM was not demonstrated on the postoperative angiograms. We emphasize the usefulness of the combination of trans-Sylvian and subtemporal approaches for this lesion, because the feeding arteries are easily identified and retraction of the temporal lobe is alleviated. A corticotomy in the fusiform gyrus is also recommended to avoid the development of not only visual field defects but also aphasia.

Key words: arteriovenous malformation, surgical approach, temporal lobe

Introduction

Surgical treatment of arteriovenous malformation (AVM) of the medial temporal lobe was previously difficult because of its location in the deep brain. However, recent development of microsurgical techniques and increased knowledge of microsurgical anatomy have lead to more frequent success in the removal of these lesions.[2,4,6-8,11] In this report, we present three cases of medial temporal lobe AVM and discuss the surgical approaches used, with a review of the literature.

Case Reports

Case 1: A 13-year-old boy suffered a sudden onset of headache, nausea, and vomiting followed by consciousness disturbance on November 21, 1984, and underwent ventricular drainage for intraventricular hemorrhage at another neurosurgical institute. He was referred to our hospital for a radical operation 3 weeks after the onset.

Neurological examination on admission revealed no deficits. A computed tomographic (CT) scan showed an enhanced high-density area in the left medial temporal lobe, apparently lateral to the ambient cistern (Fig. 1). Left carotid angiograms disclosed a relatively large AVM fed by the anterior choroidal artery (AChA) and draining into the basal vein of Rosenthal (Fig. 2).

Two months after the onset, he underwent a radical operation using a combination of trans-Sylvian and subtemporal approaches. First, the trans-Sylvian approach was used for confirming the AChA to take precautions against premature bleeding from the AVM. The plexal and cisternal segments of the AChA were then identified by the subtemporal approach. With the AChA temporarily clipped, the walnut-sized AVM nidus was removed *via* a corticotomy in the fusiform gyrus.

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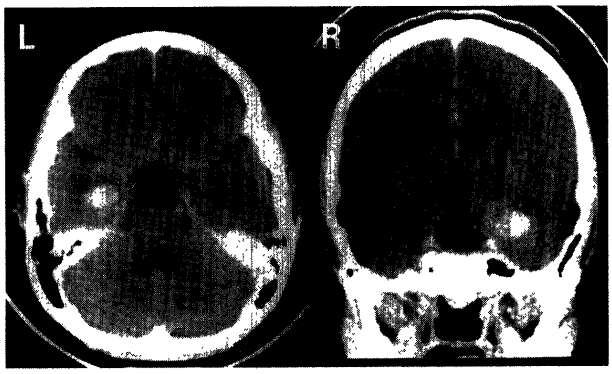

Fig. 1 Case 1. Preoperative postcontrast CT scans, showing a high-density mass in the left medial temporal lobe.

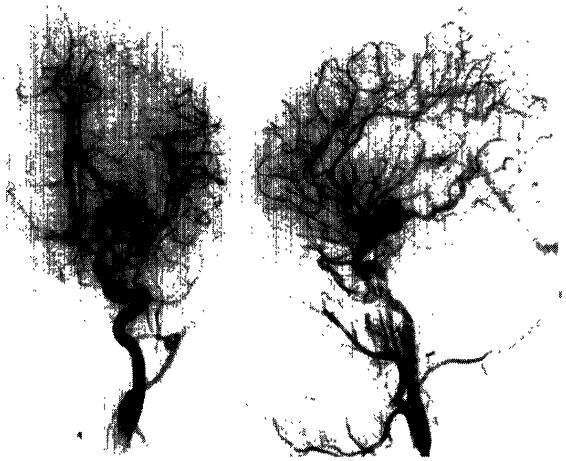

Fig. 2 Case 1. Preoperative left carotid angiograms, showing an AVM fed by the AChA and draining into the basal vein of Rosenthal.

Postoperatively, his neurological status remained intact and angiograms showed no residual AVM.

Case 2: A 28-year-old male was referred to our department from the psychiatric department of our hospital on July 28, 1983. He had been suffering from auditory hallucinations for 5 months and from dystropy for 2 months. At the age of 12 years, he experienced a sudden onset of consciousness disturbance and left hemiparesis, and underwent removal of an intracranial hematoma. At that time, no AVM was identified.

On admission, he had mild left motor and sensory disturbances and left homonymous hemianopsia, thought to be sequelae of the intracerebral hematoma. A CT scan showed a low-density area in the right occipital lobe with a markedly enhanced high-density area anteromedially. Right carotid angiograms revealed a relatively large AVM of the medial

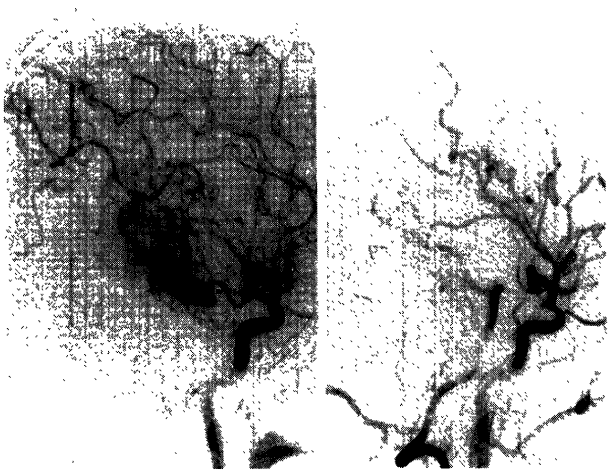

Fig. 3 Case 2. *left*: Preoperative right carotid angiogram, showing an AVM fed by the AChA. *right*: Postoperative right carotid angiogram, showing complete disappearance of the AVM.

temporal lobe, fed by an enlarged AChA (Fig. 3 *left*).

At operation, the proximal portion of the AChA was first identified by the trans-Sylvian approach. The AVM was then approached through a cortical incision in the middle temporal gyrus. The AVM nidus was successfully removed *via* the temporal horn of the lateral ventricle, after identifying the AChA close to the nidus.

Postoperative angiograms demonstrated disappearance of the AVM (Fig. 3 *right*). Although he showed impaired consciousness and aggravated left hemiparesis due to vasospasm and tension pneumocephalus 1 week after the operation, he has only mild left hemiparesis at present.

Case 3: A 53-year-old male suffered a sudden onset of right paresthesia and right homonymous hemianopsia on February 11, 1981, and was admitted to our hospital with additional headache, nausea, and vomiting 3 days later. He had an episode of subarachnoid hemorrhage 2 years prior to admission.

On admission, the only neurological abnormalities were right homonymous hemianopsia and neck stiffness. A CT scan disclosed a small, slightly enhanced high-density area suggestive of an intracerebral hematoma with partial calcification in the left medial temporal lobe. Left vertebral angiograms discovered a small AVM fed by the lateral posterior choroidal artery and draining into the vein of Galen (Fig. 4 *upper*). The AVM could not be detected by left carotid angiography (Fig. 4 *lower*).

Sixteen days after onset, a radical operation was performed. Cerebrospinal fluid was aspirated

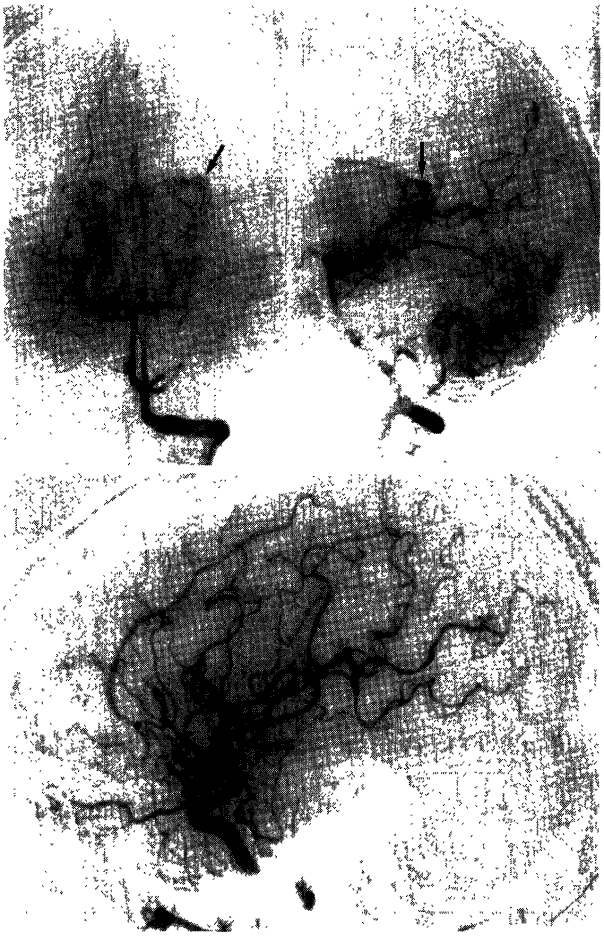

Fig. 4 Case 3. *upper*: Preoperative left vertebral angiograms, showing a small AVM (*arrow*) fed by the lateral posterior choroidal artery and draining into the vein of Galen. *lower*: Preoperative left carotid angiogram, showing no vascular abnormality.

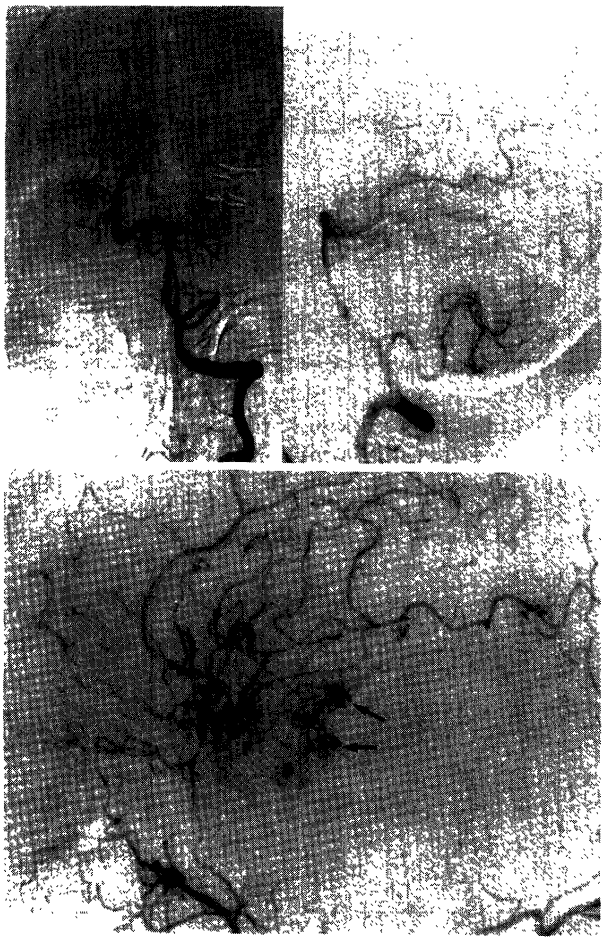

Fig. 5 Case 3. *upper*: Postoperative left vertebral angiograms, showing complete disappearance of the AVM. *lower*: Left carotid angiogram at the second admission, showing a recurrent AVM (*arrows*) fed by the AChA, which was not seen on the previous angiograms.

through the trans-Sylvian approach to retract the brain sufficiently. The posterior cerebral artery (PCA) was then confirmed by the subtemporal route. An incision was made in the middle temporal gyrus to approach the AVM *via* the temporal horn of the lateral ventricle. However, the ventricle could not be identified. The abnormal vessels fed by the PCA could be revealed by evacuating the intracerebral hematoma and were totally resected.

Postoperatively, hemiparesis on the right side and aphasia developed but improved after physical therapy. He returned home unaided with mild aphasia 6 months after the operation. Postoperative vertebral angiograms showed complete disappearance of the AVM (Fig. 5 *upper*), and carotid angiograms demonstrated no AVM.

He had mild apoplectic episodes with headache in July and October of 1982, and was readmitted due to sudden decrease in consciousness level on November 14. Neurological examination discovered signs of uncal herniation: deep coma, absence of light reflex, and decerebrate posture. A CT scan showed a high-density area extending from the left medial temporal lobe to the midbrain and pons, a considerable midline shift, and ventricular dilatation. Left carotid angiograms demonstrated an AVM fed by the AChA (Fig. 5 *lower*). He underwent ventricular drainage and external decompression on the day of admission, but died 1 month later.

Discussion

The incidence of medial temporal lobe AVM is about 3-4% of all intracerebral AVMs.[2,5] Various terms, anterior choroidal AVM,[10] AVM of hippocampal area,[3] juxtapeduncular angioma,[2] subtrigon AVM,[3]

juxtathalamic AVM,[1] and angioma of the external wall of the fissure of Bichat,[9] have all been used to describe AVM of the medial temporal lobe. Such AVMs are definitely located in the hippocampus or parahippocampal gyrus, are usually fed by the AChA or branches of the PCA, inferior temporal or lateral posterior choroidal artery, and drain into the vein of Rosenthal or the medial Sylvian vein. AVMs in this region are sometimes fed by both the AChA and the lateral posterior choroidal artery.

Previously, surgical treatment of medial temporal lobe AVM was considered difficult, but recently, reports of successful removal have increased in number.[2,4,6-8,11] Heros[6] described the following neuroradiological findings to assess the surgical suitability of these lesions: 1) primary supply by the AChA or lateral branches of the PCA, 2) primary drainage into the vein of Rosenthal or medial Sylvian vein, 3) projection beneath the middle cerebral artery on the lateral view of the carotid angiogram, 4) projection lateral to the PCA on the anteroposterior or Towne's view of the vertebral angiogram, 5) temporal lobe hematoma on CT scans, and 6) intraventricular hematoma on CT scans. If these criteria are met, resection of the AVM is likely to be easier because of the reduced risk of damage to the internal capsule upwards and to the midbrain medially.

AVMs of the medial temporal lobe have been approached by three surgical routes: the transventricular, subtemporal, and transcallosal. The transcallosal route is used for the AVM located posteriorly, especially in the lateral ventricle, and is therefore inappropriate for AVMs of the medial temporal lobe. The transventricular route is useful for anterior AVMs fed by the AChA. Hashi[5] reported that the corticotomy should be made within 6 cm from the tip of the temporal lobe to avoid postoperative visual field defects and that the lesion in the dominant hemisphere should be approached through an incision in the inferior temporal gyrus to avoid dysphasia. In general, the subtemporal route is used for posterior AVMs fed by branches of the PCA. In such cases, visual field defects can be avoided by approaching through an incision in the fusiform gyrus, as pointed out by Drake[3] and Heros.[6] Recently, good surgical results have been achieved by the trans-Sylvian approach.[12,13]

The AVM in Case 1 was mainly fed by the AChA and was located in the dominant hemisphere. The corticotomy was made in the fusiform gyrus by the subtemporal approach to preserve the speech function and visual field, and successful removal was achieved. Case 2 had a relatively large AVM fed by the AChA. The lesion was resected through the transventricular route by making an incision in the middle temporal gyrus, since it was located in the non-dominant hemisphere and left homonymous hemianopsia was preoperatively present. In Case 3, the AVM was fed by the lateral posterior choroidal artery, so the initial attempt used the subtemporal route to confirm the PCA and to make an incision in the fusiform gyrus. However, since the vein of Labbé was considerably stretched and the visual field defects were preoperatively present, the incision was made in the middle temporal gyrus of the dominant hemisphere. However, the ventricle could not be identified, and this procedure resulted in postoperative hemiparesis and speech disturbance. This patient died of hemorrhage from a recurrent AVM fed by the AChA 22 months later, although the AVM was not demonstrated on postoperative angiograms. This result suggests that the previous AVM was fed by both the AChA and the lateral posterior choroidal artery, and the anterior part of the AVM, called the reserve nidus, was left unresected. If the AChA had been identified at the first operation by the transventricular route, the second fatal hemorrhage would have been prevented.

The trans-Sylvian approach was first used for evacuating the cerebrospinal fluid to retract the brain sufficiently in all three cases, and for confirming the AChA to take precautions against premature bleeding from the AVM in Cases 1 and 2. This procedure can alleviate retraction of the temporal lobe required in the next stage of subtemporal approach, and leads to easier identification of the AChA and PCA by both the trans-Sylvian and the subtemporal approaches. For an AVM located in the anterior medial temporal lobe, as in Case 1, an approach through a corticotomy in the fusiform gyrus is easy and reduces the risk of not only visual field defects but also speech disturbance. This route is also useful for an AVM in the posterior medial temporal lobe, but is not always easy due to problems in the preservation of the vein of Labbé. In such cases, the transventricular route can be used instead. However, an incision in the middle temporal gyrus of the dominant hemisphere may cause dysphasia as in Case 3. Therefore, the transventricular approach through an incision in the lower portion of the temporal lobe should be considered in the dominant hemisphere.

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Address reprint requests to: N. Oka, M.D., Department of Neurosurgery, Toyama Medical and Pharmaceutical University, 2630 Sugitani, Toyama 930-01, Japan.