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Case Reports & Case Series

Removal of superior vermian arteriovenous malformation through the occipital transtentorial approach

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ABSTRACT

Background: Arteriovenous malformations (AVMs) of the superior vermis are extremely rare. Although they have a higher rate of hemorrhagic presentations than supratentorial AVMs, the surgical approaches for AVMs at this location remain controversial.

Case description: We report the case of a 73-year-old man with a hemorrhagic superior vermian AVM that was treated with surgical resection through the occipital transtentorial approach (OTA). This approach, with a direct perpendicular view of the whole lesion, enabled us to control the feeding arteries safely and to finally accomplish a total resection.

Conclusions: The OTA is an elegant approach for the resection of superior vermian AVMs. Detailed assessment of angiographic features is mandatory in selecting an effective and safe surgical approach for posterior fossa AVMs depending on their location.

1. Introduction

Although arteriovenous malformations (AVMs) of the cerebellum are relatively uncommon, they demonstrate a higher rate of hemorrhagic presentations than supratentorial AVMs. To successfully remove these malformations, it is essential to select appropriate surgical approaches from among several options. Among posterior fossa AVMs, the superior vermian type is accounting for only a small percentage (3%) of all cerebral AVMs [1]. The surgical treatment of superior vermian AVMs is relatively difficult, and few reports have described the available approaches in detail. Furthermore, controversy remains about which surgical approach is appropriate for this type of AVMs [1,2]. In the present report, we describe the detail procedure of superior vermian AVM removal through the occipital tentorial approach (OTA), and discuss the surgical approaches for AVMs at this location.

2. Case report

A 73-year-old man presented with sudden headache and showed slight disturbance of consciousness, dysarthria, ataxia of the left limb, and truncal ataxia. Magnetic resonance imaging evaluation showed fine vasculatures in the superior vermis, indicating an AVM (Fig. 1A, B). Then, cerebral angiography demonstrated a 3-cm nidus at the location. The superior cerebellar arteries (SCAs) and posterior inferior cerebellar arteries (PICAs) were the main feeders supplying blood to the anterior and posterior portion of the nidus, respectively (Fig. 1C). The left PICA was branching to the left and right vermian branches. The venous phase of angiography showed that the superior vermian vein was draining to the vein of Galen (Fig. 1D).

Considering the anatomical location of the nidus, feeding arteries, and draining vein, we planned surgical removal through the OTA. Preoperative embolization was performed on day 9 after disease onset. Two branches of the left SCA and the left and right vermian branches from the left PICA were embolized. Thus, flow reduction was obtained in the posterior part of the nidus supplied by the PICA (Fig. 1E, F).

Surgical removal was performed on day 12 (Fig. 2A). Because the nidus was slightly shifted to the left, the patient was placed in a park-bench position with the left side down, to allow easier retraction of the left occipital lobe under gravity. A J-shaped left occipital skin incision was made, and a wide rectangular occipital craniotomy crossing the superior sagittal sinus was performed to ensure a wide working trajectory and to facilitate brain retraction by gravity (Fig. 2B). We

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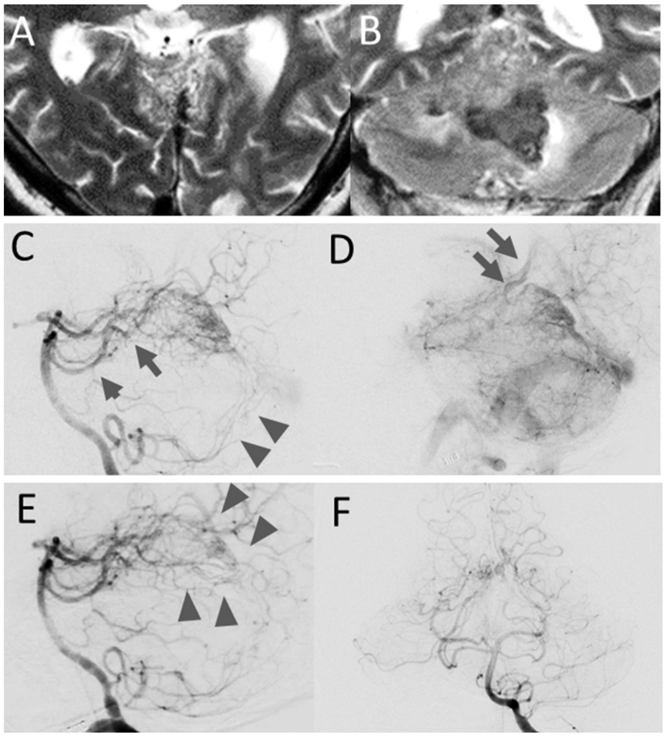

Fig. 1. (A) Axial and (B) coronal magnetic resonance images show abnormal vasculatures indicating arteriovenous malformation in the superior vermis in addition to intracerebellar hemorrhage. (C) Arterial and (D) venous phases of vertebral angiographies show the arteriovenous malformation (AVM). The main feeders of the AVM are the bilateral superior cerebellar arteries (arrows) and posterior inferior cerebellar arteries (arrow heads). The draining vein from the AVM is the superior vermian vein (D, arrows). (E) Lateral and (F) coronal view of vertebral angiographies after endovascular embolization demonstrate flow reduction of the posterior part of the nidus (arrows).

considered the risk of downward herniation due to the mass effect of ICH and AVM when spinal drainage was conducted. After the craniotomy, cerebrospinal fluid was drained through puncture of the left posterior horn of the ventricle and by opening the quadrigeminal cistern, which further helped the retraction of the left occipital lobe. After visualizing the straight sinus on indocyanine green video angiography, the left tentorium was cut from the edge in parallel with the straight sinus. In the present case, cutting of the tentorium was stopped at the point where bleeding from the tentorial sinus occurred (Fig. 2A). When the tentorium flap was retracted, the left side of the nidus was exposed and the embolized left SCA was observed. Then, the falx was retracted to the contralateral side so that a perpendicular view looking down the anterior part of the nidus was obtained (Fig. 2C). The left SCA was coagulated and cut, and removal of the nidus was started. Then, the right SCA, which was the nonembolized feeder, was also coagulated and cut. During dissection of both sides of the nidus, the intracerebral hematoma was aspirated and decompressed. However, as mentioned above, the cutting of tentorium was not enough and it was still difficult to visualize the posterior part of the nidus. Therefore, the cutting was carefully extended toward the posterior side by coagulating the tentorial sinus. This eventually provided a wide view of the posterior part of the nidus and both vermian branches of the PICA. Then, these branches were sacrificed and the nidus was dissected completely. Finally, the main drainer was ligated and the lesion was totally removed.

Postoperative angiography demonstrated complete removal of the AVM (Fig. 2D). The patient's postoperative course was uneventful, and he was transferred to another rehabilitation hospital after a month with improved preoperative neurological deficits.

3. Discussion

Besides the OTA, the posterior subtemporal approach and supracerebellar infratentorial approach could be options as surgical routes to the superior vermis [2]. The posterior subtemporal approach offers a relatively short distance to the posterior cerebral artery or the SCA from the brain surface. However, the operative view is limited to the proximal portion of these vessels and the surgical trajectory is lateral, making it difficult to expose the midline and the contralateral side of the lesion. Furthermore, there is a potential risk of venous congestion due to the retraction of the temporal lobe.

The supracerebellar infratentorial approach is useful for posterior infratentorial lesions. This approach provides operative views ranging from the splenium of the corpus callosum to the cerebello-mesencephalic fissure including the quadrigeminal cistern [3]. However, when it is applied to AVMs, it is difficult to expose arteries feeding the anterior part of the nidus. Moreover, a nidus or dilated drainer will also become an obstacle owing to the surgical trajectory from the posterior side. In addition, when the cerebellar hemispheres and the vermis are retracted downward, veins between the cerebellum and the tentorium may need to be sacrificed. Sacrificing those veins before controlling the feeding arteries may cause brain edema or hemorrhagic complications.

The OTA can eliminate the above-mentioned disadvantages of the other approaches. One of the main advantages of this approach is a broad perpendicular view of the supracerebellar space including the quadrigeminal cistern, which makes it easier to obtain anatomical orientations and to expose feeding arteries when applied to AVMs. In addition, the SCAs, which often are the feeders of superior vermian AVMs, can be controlled in the early stage of the procedure.

Nowadays OTA is performed in the prone, lateral, semilateral, or park-bench position, depending on the surgeon's preference [4,5]. These positions allow the occipital lobe to fall owing to the effect of gravity and minimize the need for occipital lobe retraction. Drainage of cerebrospinal fluid through lumbar puncture, ventricle puncture, or opening the arachnoid of the quadrigeminal cistern can further minimize such a requirement. Recently, favorable outcomes of the OTA with preoperative partial embolization, as in the present case, were also reported [2,5].

Several potential limitations of the OTA should be noted. First, there is a risk of hemianopsia due to occipital lobe injuries caused by its retraction [4]. However, this can be avoided by minimizing occipital lobe retraction, as mentioned above. Visual evoked potential monitoring is also useful option to reduce the risk. Second, if the tentorial sinus is prominent as in the present case, it can limit the transtentorial approach [2]. Intraoperative Doppler sonography or indocyanine green videoangiography may help to detect it although preoperative angiography did not detect it in the present case. It would be possible to cut tentorial sinus by careful coagulation or suturing in most cases. However, when the tentorium incision cannot be performed, the incision of the contralateral tentorium or other surgical approach such as supracerebellar infratentorial approach should be considered. Third, the operative view of the contralateral side is generally limited in the OTA. In such a case, a bi-tentorial incision provided greater contralateral exposure of the posterior incisural space. Other surgical approaches can also be used in combination when the lesions are extending far laterally or caudally.

4. Conclusions

The OTA is an elegant approach for superior vermian AVMs, offering a broad operative view exposing the relevant abnormal vasculatures. A detailed assessment of angiographic features is mandatory in evaluating the feasibility of safe preoperative embolization and in selecting an effective surgical approach for posterior fossa AVMs depending on their location. Even when reaching the tentorial surface of the cerebellum by OTA, it is not always necessary to make a wide

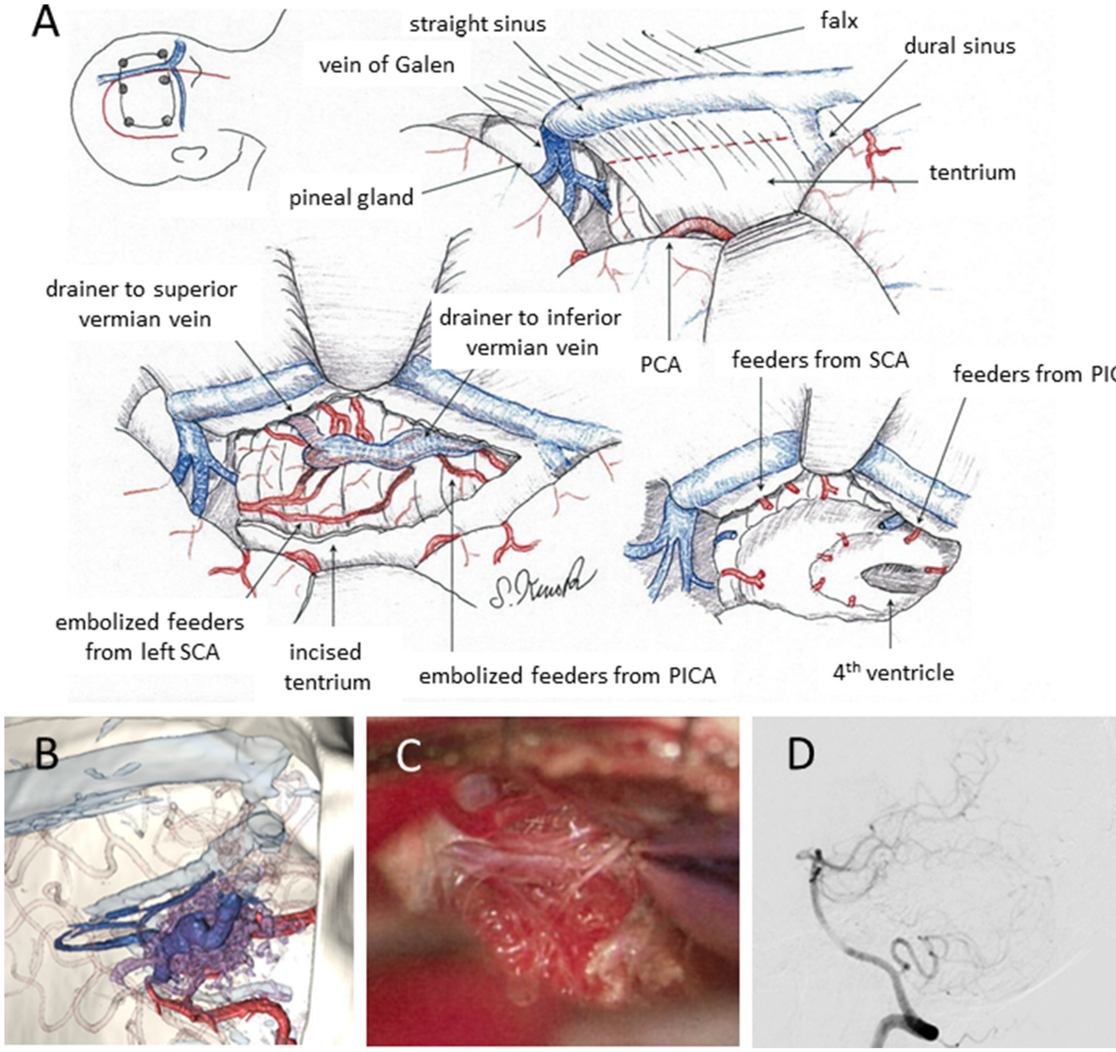

Fig. 2. (A) Illustrations of intraoperative views of the occipital transtentorial approach from positioning to resection of the lesion. (B) Fusion 3-dimentional image of bone and cerebral angiography shows postero-lateral view of the AVM from a window of craniotomy. (C) Intraoperative image after incision of tentorium shows perpendicular view of the AVM. (D) Lateral projection of postoperative vertebral angiography shows complete resection of the AVM.

craniotomy to the lateral direction, but in this case, it was enlarged considering the lesion.

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