Cavernous Malformation of the Ventral Midbrain Successfully Removed Via a Transsylvian-Transpeduncular Approach
—Case Report—

Tadahiro OHMURA, Katsuyuki HIRAKAWA, Mika OHTA, Hidetsuna UTSUNOMIYA*, and Takeo FUKUSHIMA

Departments of Neurosurgery and *Radiology, Fukuoka University Faculty of Medicine, Fukuoka

Abstract

A 37-year-old woman presented with a rare cavernous malformation of the ventral midbrain with brainstem hemorrhage manifesting as sudden onset of headache and vomiting. The lesion was removed successfully through a transsylvian approach and a medial peduncular route. Postoperatively, her oculo-motor nerve paresis worsened temporarily, but diplopia disappeared 2 months after surgery. We recommend the transsylvian-transpeduncular approach if the lesion is located in the ventral midbrain and faces the ventral surface of the brainstem, because of the effective access with minimal neurological deficits.

Key words: cavernous malformation, ventral midbrain, surgical approach, transsylvian-transpeduncular route

Introduction

Brainstem cavernous malformations are rare, but account for 9% to 35% of all cavernous malformations. Supratentorial cavernous malformations tend to manifest as seizures, and infratentorial cavernous malformations as cranial nerve paresis, whereas brainstem cavernous malformations are commonly associated with hemorrhage, and neurological deficits after hemorrhage are common. Cavernous malformation is frequently associated with venous malformation, which increases the incidence of hemorrhage. The associated venous malformation must be preserved if the cavernous malformation is resected because of the critical involvement in providing normal drainage.

Radiosurgery decreases the incidence of hemorrhage but often causes neurological deficits, and can also reduce seizure frequency with time. No histological evidence of vascular changes was found in surgical specimens of vascular malformations after radiosurgery or conventional radiation.

Surgical treatment of such malformations to prevent re-bleeding is possible, but always difficult because of the depth and limited exposure of the lesion. In particular, ventral midbrain lesion is so far from the brain surface that surgical treatment is rarely indicated. Here we describe the successful removal of a cavernous malformation in the ventral midbrain via a transsylvian-transpeduncular approach.

Case Presentation

A 37-year-old woman presented at another hospital with sudden onset of headache and vomiting. She was referred to us 2 days later. On admission to our hospital, neurological examination revealed right dysesthesia, hypesthesia, mild hemiparesis, and left oculomotor nerve paresis.

Computed tomography showed intrinsic hemorrhage extending from the right cerebral peduncle to the periaqueductal gray matter in the ventral midbrain (Fig. 1). Magnetic resonance imaging revealed a heterogeneous lesion with evidence of blood products in various stages of degeneration (Fig. 2). Cerebral angiography depicted a venous malformation lying anteriorly to the ponto-mesencephalic junction, but no feeding artery or draining vein.
The patient underwent surgical resection of the cavernous malformation via a transsylvian-transpeduncular approach on day 28 after the initial presentation. A left pterional approach was used to expose the left cerebral peduncle by a transsylvian route. The sylvian fissure was widened to expose the emergence of the left oculomotor nerve. The cerebral peduncle was swollen, but neither hematoma nor cavernous malformation was observed on the surface of the midbrain (Fig. 3). An anomalous vein emerged from the lateral midbrain and coursed ventrally to the ponto-mesencephalic junction, suggesting venous malformation. The posterior cerebral artery and superior cerebellar artery were identified just above and below the oculomotor nerve, respectively, then a 5-mm-long vertical cortical incision was made between these arteries, just lateral to the emergence of the oculomotor nerve and medial to the pyramidal tract. The 5-mm incision did not expose the hematoma cavity, so the incision was extended 3 mm rostrally after the posterior cerebral artery was displaced inferiorly. The hematoma cavity was found 3 mm below the surface. The hematoma contained brownish, liquefied material and clotted blood, and was aspirated and removed with microdissectors and a suction tip, exposing a dark vascular conglomerate resembling a mulberry. The conglomerate was removed after being dissected from the surrounding gliotic tissue.

Histological examination of the specimen showed vascular spaces of various sizes lined with a single layer of endothelial cells, multiple hemosiderin deposits, and widespread gliosis, which were consistent with cavernous malformation.

The patient’s oculomotor nerve paresis worsened temporarily, but later improved, and diplopia disappeared 2 months after surgery. The right sensory disturbance and hemiparesis also improved, and she returned to normal life as a housewife. Postoperative magnetic resonance imaging confirmed total removal of the vascular lesion and disappearance of the mass effect (Fig. 4).

**Discussion**

Brainstem cavernous malformation is associated with increased frequency of bleeding or re-bleeding, so treatment should be designed to prevent acute bleeding, especially if a hemorrhagic episode has already occurred. Surgical treatment has an overall morbidity and mortality rate of 35%, a permanent or
Fig. 4  Postoperative axial (A) and sagittal (B) T1-weighted magnetic resonance images showing that the cavernous malformation had been totally removed.

Fig. 5  Surgical field drawing of the midbrain showing the topographical anatomy of the oculomotor nerve (ON) and cerebral peduncle. Arrow: approach, 1: fronto-pontine fibers, 2: pyramidal fibers, 3: temporo-pontine fibers.

Severe morbidity rate of 12%, and a temporary complication rate of 23%. However, conservative management resulted in death in 20% or more of patients and severe disability in 7%, mostly due to hemorrhage or progressive growth of the cavernous malformation. However, no operative mortality occurred and 99 patients (72.3%) either improved or remained clinically stable among 137 cases of surgically treated brainstem cavernous malformations.

The pterional-transsylvian approach, bifrontal approach through the lamina terminalis, transcortical approach, subtemporal approach, and lateral transpetrous approach have been reported as surgical approaches to ventral midbrain lesions. Relatively early surgery — within 4 to 6 weeks of the hemorrhage — has been recommended because the procedure will be easier if the hematoma is still unorganized and no significant amount of fibrous perilesional gliotic tissue has developed. Most previous reports used a cortical incision at the focal bulge and/or discolored part of the cortical surface. Cavernous malformation in the cerebral peduncle required a minimal 3-to-5 mm incision parallel to the fiber tracts initially. Surgical access to the ventral mesencephalon can be obtained through a “fairly safe entry zone” delimited above by the posterior cerebral artery, below by the superior cerebellar artery, medially by the emergence of oculomotor nerve and the basilar artery, and laterally by the pyramidal tract (Fig. 3B). We used a 5-mm long vertical incision in the cortical surface through this entry zone, and added a 3-mm upward incision to reach the hematoma cavity by displacing the posterior cerebral artery.

The cerebral peduncle consists of corticospinal, corticonuclear, and corticopontine fibers. The corticospinal and corticonuclear tracts occupy only the middle two-thirds or so of the peduncle, and the corticopontine fibers form the rest. The center sixth of the peduncle consists of frontopontine fibers, and the most lateral sixth consists of temporopontine fibers. Therefore, there is a window between the emergence of the oculomotor nerve from the median groove and the pyramidal fibers in the peduncle that affords surgical access to the ventral midbrain through the more medial part of the peduncle and prevents injury to the motor tract (Fig. 5). In our case, we made an 8-mm vertical incision in the medial part of the peduncle by the emergence of the oculomotor nerve and removed the cavernous malformation without permanent disruption of any neurological function.

The present case shows that a cavernous malformation in the ventral midbrain can be successfully removed via a transsylvian-transpeduncular route without additional permanent complications.

References


Address reprint requests to: Tadahiro Ohmura, M.D., Department of Neurosurgery, Fukuoka University Faculty of Medicine, 7–45–1 Nanakuma, Jonan ward, Fukuoka 814–0180, Japan.
E-mail: tadaohm@fukuoka-u.ac.jp