Direct Approach to the Ventrolateral Medulla for Cavernous Malformation

—Case Report—

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Abstract

A 49-year-old man presented with symptomatic cavernous malformation in the ventrolateral portion of the medulla oblongata manifesting as left-sided numbness and gait disturbance. Neurological examination disclosed sensory disturbance on the left, cerebellar ataxia, nystagmus, dysphagia, and right hypoglossal nerve paresis. Magnetic resonance imaging revealed a cavernous malformation with hemorrhage occupying the right paramedian field of the medulla oblongata. The patient underwent complete removal of the lesion through vertical incision of the bulging surface of the ventrolateral medulla, anatomically coinciding with the inferior olive. The neurological deficits improved without additional postoperative deficits. This unusual microsurgical approach through a ventrolateral medullary incision permits direct resection of a subpial intrinsic lesion, even on the ventral medulla.

Key words: cavernous malformation, direct surgery, ventral medulla

Introduction

Cavernous malformation in the brainstem has a higher incidence of bleeding and rebleeding than in other locations.^{5,7,13-16,21} Neurological deficits are likely to worsen due to repeated hemorrhages, so the current trend is toward aggressive management of lesions reaching the pial or ependymal surface of the brainstem, but extreme care is required perioperatively since vital structures in life-support functions are located at the brainstem.^{2,5,9,11-14,16,21} Direct resection through various approaches has been used for cavernous malformations located primarily in the midbrain and pons since there is only minor risk of inflicting further neurological damage.^{4,6,8,10-12,17-19} The indications for surgical treatment and selection of the most appropriate surgical routes may be indeterminable for cavernous malformations with neither bulging nor extension into the pial or ependymal surface.

We describe an uncommon microsurgical approach for subpial intrinsic cavernous malformation located primarily in the ventrolateral portion of the medulla oblongata.

Case Report

A 49-year-old man noticed left-sided numbness and gait disturbance accompanied by truncal ataxia on April 11, 1998. He visited a neurosurgical clinic on April 14, 1998, where magnetic resonance (MR) imaging disclosed a vascular lesion in the medulla oblongata. He was referred to our hospital for further evaluation.

On admission, neurological examination disclosed sensory disturbance on the left including the face, truncal and limb ataxia, horizontal and upbeat nystagmus, mild dysphagia, and right hypoglossal nerve paresis. Additional MR imaging revealed a heterogeneous vascular mass 10 mm in diameter, suggesting cavernous malformation associated with hemorrhage (Fig. 1). The mass occupied primarily the right paramedian area of the medulla oblongata with bulging of the pial surface of the ventrolateral medulla. Angiography found no abnormal vessels or vascular staining. Three weeks after onset, the patient underwent surgical removal of the lesion to prevent further neurological deficits due to repeated hemorrhage.

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Fig. 1 Preoperative axial T₂-weighted magnetic resonance (MR) image (A) demonstrating a heterogeneous mass at the right paramedian portion of the medulla oblongata with bulging of the pial surface. Preoperative sagittal T₁-weighted MR image (B) revealing a well-circumscribed mass lesion with a hyperintense area due to bleeding.

A right suboccipital craniectomy was performed that extended laterally to the condylar fossa, and a C-1 hemilaminectomy was performed to expose the ventrolateral portion of the medulla oblongata. After opening the dura, the lateral aspect of the medulla was widely exposed by mild cerebellar retraction (Fig. 2A). The radices cerebrales of the accessory nerve extended from the tuberculum cinereum of

the medulla oblongata. The vagal and glossopharyngeal nerves were identified rostrally. The hypoglossal nerve and C-1 ventral root were present ventrally. The C-1 root course extended laterally over the vertebral artery. White and slightly discolored brain bulging was observed between the radices cerebrales of the accessory and hypoglossal nerves, and just below the vagal nerve, located anatomically at the inferior olive. This area was abnormally soft on palpation, suggesting the presence of a subpial hematoma cavity. A 3-mm vertical corticotomy was carried out through the radices cerebrales of the accessory nerve. A 3-mm deep hematoma cavity was found, which contained a brownish clot and xanthochromic tissue. The hematoma cavity was enlarged using microdissectors to expose a dark vascular conglomerate that resembled a cluster of mulberries, which was located in the ventromedial area of the cavity. Fine feeding vessels and draining veins were coagulated and divided. The conglomerate was dissected from the surrounding gliotic tissue and removed en bloc (Fig. 2B). The somatosensory evoked potentials were confirmed to be within normal limits during the operation. The patient tolerated the procedure well with his vital signs remaining stable throughout.

The recovery was uneventful with no additional neurological deficits. Postoperative MR imaging demonstrated total removal of the vascular lesion (Fig. 3). Histological examination confirmed the di-

Fig. 2 Intraoperative photograph (A) showing the lateral aspect of the medulla is widely exposed with mild cerebellar retraction after the dura mater was opened. The radices cerebrales of the accessory nerve are seen at the posterior lateral sulcus of the medulla oblongata. Intraoperative photograph (B) showing the medullary incision is made vertically on the discolored and distended brain through the radices cerebrales of the accessory nerve. The hematoma cavity, which was apparent a few millimeters under the pial surface, contained the cavernous malformation.

Fig. 3 Postoperative axial T₂-weighted magnetic resonance (MR) image (A) showing that the cavernous malformation has been totally removed, and a small high-signal line is apparent around the route of the ventrolateral medullary incision. Postoperative sagittal T₁-weighted MR image (B) also demonstrating disappearance of the lesion.

agnosis of cavernous malformation with hemorrhage. The cerebellar ataxia, nystagmus, and hypoglossal nerve paresis gradually improved and he was discharged ambulatory 47 days after surgery. The patient complained of tightness in the shoulders, but returned to his previous job 1 year 3 months later.

Discussion

Direct surgery was selected for the present case of symptomatic cavernous malformation with bulging of the pial surface of the ventrolateral medulla. The trans-fourth ventricular approach and midline myelotomy below the obex are the typical surgical routes for dorsal intrinsic lesions of the brain stem or dorsal medulla. These approaches were inappropriate for this patient because the lesion was located further from the intact floor of the fourth ventricle and was off the midline. The trans-fourth ventricular approach carried the risk of further neurological damage. The microsurgical approach through the bulging surface of the ventrolateral medulla prevented additional damage to the brainstem. The cavernous malformation was completely removed after incising a few millimeters of the discolored and distended medulla, which was thought to be the inferior olive. The patient's recovery was uneventful with no additional deficits, and he was discharged after the preoperative neurological deficits improved. These findings suggest that the microsurgical approach for intrinsic brainstem lesions should be selected after consideration of the microsurgical anatomy, neuroimages, and patient's

neurological history.

The surgical approach depends on the location of the cavernous malformation in the brainstem, and the technical considerations for surgical intervention to treat intrinsic lesions of the ventral medulla.^{1-3,11,20} Surgery has been considered risky due to the possibility of injuring vital structures or damaging the perforating arteries coursing from the ventrolateral aspect of the medulla. Safe entry zones might be identified, even on the anterior surface of the medulla, through an anterolateral sulcus at the level between the radicles of the hypoglossal nerve and the C-1.³ Since the present lesion was mainly located at the level of the inferior olive, this paramedian oblique route through the anterolateral sulcus carried greater risk. Therefore, direct medullary incision of the discolored and bulging surface of the medulla was carefully performed. The good outcome suggests that a subpial intrinsic lesion of the medulla oblongata associated with a hematoma can be directly approached via ventrolateral incision between the radices cerebri of the accessory nerve and the hypoglossal nerve.

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