Traumatic Lesions of the Bilateral Middle Meningeal Arteries

—Case Report—

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Abstract

A 44-year-old man presented with traumatic injuries of the bilateral middle meningeal arteries after a traffic accident. Neurological examination found left visual impairment due to left optic nerve injury. Computed tomography demonstrated a small amount of left epidural hemorrhage and bilateral skull fractures. Left external carotid angiography revealed a pseudoaneurysm of the left middle meningeal artery at the sphenoid ridge. Right external carotid angiography demonstrated a dural arteriovenous fistula fed by the right middle meningeal artery colocated with the right frontal convexity fracture. Transarterial embolization of the left middle meningeal artery pseudoaneurysm with four fibered platinum coils and transarterial embolization of the right dural arteriovenous fistula with poly(2-hydroxyethyl methacrylate-co-methyl methacrylate) were performed, resulting in complete obliteration of both lesions. Angiographic cure was obtained and the postoperative course was uneventful.

Key words: dural arteriovenous fistula, pseudoaneurysm, middle meningeal artery

Introduction

Traumatic cerebrovascular injury may not be identified immediately in patients with head injury because cerebral angiography is not often performed on admission. Traumatic cerebrovascular injury should be considered in such cases.⁷⁾ We treated a patient admitted after a traffic accident for traumatic pseudoaneurysm of the left middle meningeal artery and dural arteriovenous fistula fed by the right middle meningeal artery.

Case Report

A 44-year-old man presented with head injury after being hit by a car while walking. He was admitted to our hospital on April 11, 1998. He had a lacerated wound on the left forehead. Neurological examination found his consciousness was clear. His left visual acuity was only perception of light. The right and left pupils were 3.5 mm and 5.0 mm in diameter. The left direct and the right indirect reflexes to light were lost, indicating left optic nerve injury. There was no other neurological deficit.

Skull radiography showed skull fractures in the bifrontal convexities. Computed tomography showed a skull base fracture extending to the left anterior clinoid process, a fracture of the left optic canal, and a small amount of left acute epidural hemorrhage (Fig. 1). Internal carotid and vertebral angiography found no abnormalities. However, left external carotid angiography showed a pseudoaneurysm of the left middle meningeal artery at the sphenoid ridge, consistent in location with the skull base fracture (Fig. 2). Right external carotid angiography demonstrated a dural arteriovenous fistula fed by the right middle meningeal artery, and draining into the diploic vein (Fig. 3). The shunting region was consistent in location with the right frontal convexity fracture.

Embolization was performed subsequent to cerebral angiography. A 4-F guiding catheter was placed in the left external carotid artery, and a microcatheter was advanced to the left middle meningeal artery at the middle skull base. Proximal occlusion of the pseudoaneurysm was performed using four fibered platinum coils. Next, a 4-F guiding catheter was placed in the right external carotid artery, and a microcatheter was advanced into the right middle meningeal artery as close as possible to

Fig. 1 A: Skull radiograph showing bifrontal convexity fractures. B: Computed tomography (CT) scan demonstrating a small amount of left epidural hemorrhage, and air collection. C: Bone image CT scan demonstrating skull base fractures.

Fig. 2 Left external carotid angiograms showing a pseudoaneurysm (arrowhead) of the left middle meningeal artery at the sphenoid ridge.

Fig. 3 Right external carotid angiograms demonstrating a dural arteriovenous fistula (arrowhead) fed by the right middle meningeal artery at the right frontal convexity fracture. Venous drainage is via the diploic vein.

the site of dural arteriovenous fistula. The dural arteriovenous fistula was embolized with a liquid material, poly(2-hydroxyethyl methacrylate-co-methyl methacrylate) (HEMA-MMA).³⁻⁵ Complete occlusion was obtained by both embolization procedures (Fig. 4).

The patient then continually underwent decompression of the left optic nerve under general anesthesia to treat the left optic neuropathy associated with the fracture of the left optic canal. Craniotomy exposed a fracture at the sphenoid ridge, surrounded by a small left epidural hematoma. The left middle meningeal artery was damaged by the skull base fracture, so the pseudoaneurysm may have been formed by the hematoma.

Left visual acuity recovered to finger counting, and the patient could walk alone at discharge. Cerebral angiography showed that the pseudo-

Fig. 4 Left external carotid angiogram after embolization (left) revealing complete occlusion of the pseudoaneurysm, and right external carotid angiogram (right) demonstrating complete disappearance of the dural arteriovenous fistula.

aneurysm and dural arteriovenous fistula had completely disappeared one year later.

Discussion

Traumatic internal carotid artery aneurysm is characterized by repeated epistaxis, unilateral vision disorder, and fracture extending to the orbit.⁶⁾ A case with epistaxis may be fatal.²⁾ If a patient presents with anterior skull base fracture extending to the anterior clinoid process and unilateral vision disorder, we suspect traumatic injury of the internal carotid artery and perform magnetic resonance angiography or cerebral angiography. In this case, we performed cerebral angiography which revealed the pseudoaneurysm of the left middle meningeal artery and dural arteriovenous fistula of the right middle meningeal artery, both consistent in location with the bilateral fractures.

About 70% of cases of traumatic middle meningeal artery pseudoaneurysm are associated with a fracture crossing the middle meningeal artery in the temporal region. The middle meningeal artery is injured at this site and covered by hematoma or secondary connective tissues, forming a pseudoaneurysm. Traumatic middle meningeal artery pseudoaneurysm may rapidly rupture after recovery of the cerebral contusion and the period from injury to aneurysm formation ranges from 4 to 30 days.

In our patient, we thought that proximal occlusion of the pseudoaneurysm by intravascular surgery⁸⁾ might decrease the risk of optic canal decompression. Complete embolization of the parent artery was achieved safely and quickly using four fibered platinum coils.

Dural arteriovenous fistula of the middle meningeal artery is the second most common traumatic dural arteriovenous fistula after traumatic carotid-cavernous sinus fistula.¹⁾ Like traumatic middle meningeal artery pseudoaneurysm, skull fracture is frequently associated with the fistula, forming a shunt with the parallel middle meningeal vein and diploic vein.

The clinical symptoms are consciousness disorder, headache, and bruit. The therapeutic alternatives are embolization or resection by craniotomy. Our patient had bilateral lesions of the middle meningeal arteries, so we selected intravascular surgery that can be performed safely in a short time.

Embolization with a microcoil can be used,⁹⁾ but recanalization is very frequent if the vessel was occluded proximal to the dural arteriovenous fistula. Dural arteriovenous fistula should not be occluded

at the proximal site, but should be occluded at the shunt. We successfully embolized the shunt with HEMA-MMA,³⁻⁵⁾ which is a liquid embolizing agent that can be applied safely.

The present case of left middle meningeal artery pseudoaneurysm and dural arteriovenous fistula fed by the right middle meningeal artery associated with bilateral skull fractures caused by a traffic accident suggests that intravascular embolization will obtain a good outcome.

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