Iatrogenic Arteriovenous Fistula of the Middle Meningeal Artery Caused During Embolization for Meningioma
—Case Report—

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Abstract

A 73-year-old female developed middle meningeal arteriovenous fistula during embolization of a falx meningioma. The cause of this complication was thought to be perforation by the guide wire during catheterization at the sharp bend in the sphenoidal portion of the middle meningeal artery. Embolization of the fistula and the feeding artery to the meningioma with polyvinyl alcohol particles 250–355 μm size resulted in complete obliteration of the fistula. Computed tomography showed no epidural or subdural hematoma. Introduction of the microcatheter beyond the sharp bend in the middle meningeal artery should not be attempted to avoid the possibility of iatrogenic middle meningeal arteriovenous fistula.

Key words: arteriovenous fistula, complication, embolization, middle meningeal artery, meningioma

Introduction

Interventional neuroradiology now enables the safe and easy preoperative embolization of meningioma. Preoperative embolization of meningiomas is routinely performed with relatively few complications.2,4,5,7,9,14 However, subdural or subarachnoid hemorrhage associated with embolization of meningioma has occurred.4,7,9,14 Recently, a carotid-cavernous fistula occurring after embolization of a cavernous sinus meningioma was reported.9 We describe a similar complication of the middle meningeal arteriovenous fistula (AVF) caused by an embolization procedure in the middle meningeal artery which was the feeder of a meningioma.

Case Report

A 73-year-old female was admitted to our hospital because of gradual weakness of her left upper and lower extremities. Magnetic resonance imaging demonstrated an iso-intensity mass in the right frontal lobe with marked contrast enhancement (Fig. 1). Angiography revealed a moderately stained tumor fed by the middle meningeal artery (Fig. 2). Embolization of the middle meningeal artery was planned be-
fore surgery. A Tracker-18 catheter (Target Therapeutics, Fremont, Cal., U.S.A.) was navigated into the middle meningeal artery via a 6 F guiding catheter placed in the right external carotid artery. A 0.016" Terumo standard guide wire with 90° angle (Terumo, Tokyo) was easily introduced into the middle meningeal artery. However, the middle meningeal artery was tortuous at the sphenoidal portion. The guide wire was gently advanced and rotated to navigate distally. However, she complained of mild headache when the guide wire was advanced. Therefore, the guide wire was gently retrieved. Superselective angiography of the middle meningeal artery demonstrated a newly formed middle meningeal AVF which drained into the middle meningeal vein and then the basal dural vein (Fig. 3). We attempted to navigate the catheter beyond the fistulous point but failed because of the tortuosity of the middle meningeal artery.

The middle meningeal artery was embolized with polyvinyl alcohol (PVA) particles of 250–355 μm size, because the expected size of the fistula was less than 400 μm as the diameter of the Terumo 0.016" guide wire is 400 μm. The PVA particles were gently injected into the middle meningeal artery via the Tracker-18 catheter introduced into the proximal portion of the middle meningeal artery. After the embolization, the tumor stain and AVF had completely disappeared (Fig. 4). Computed tomography after

Fig. 2 Right external carotid angiogram demonstrating tumor staining of the falx meningioma, which is mainly supplied from the middle meningeal artery.

Fig. 3 Superselective angiogram of the middle meningeal artery (thick arrows) demonstrating the tumor stain of the anterior falx as well as the arteriovenous fistula (arrowhead) of the middle meningeal artery, which drains into the basal dural vein (arrows) via the middle meningeal vein.

Fig. 4 Right external carotid angiogram after embolization showing the arteriovenous fistula and meningioma stain have completely disappeared.

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the embolization showed no epidural or subdural hematoma. The patient subsequently underwent surgery and the embolized tumor was totally removed without difficulty. Follow-up angiography showed the AVF had completely disappeared.

**Discussion**

Middle meningeal AVF frequently occurs after head injury. The AVF in the present case was due to vessel perforation of the middle meningeal artery to the middle meningeal vein by the guide wire. Vessel perforation is one of the most serious complications during interventional neuroradiological procedures. Vessel perforation of the cerebral artery usually occurs in a portion of the artery with a sharp bend. In our case, perforation occurred at the sphenoidal portion of the middle meningeal artery with a sharp bend. If the vessel perforation occurs in the cerebral artery, it usually causes intracerebral or subarachnoid hemorrhage. In our case, the guide wire perforated the middle meningeal artery toward the middle meningeal vein and a new AVF developed. If the middle meningeal artery had been perforated toward the brain tissue, a subdural hemorrhage may have occurred.

Middle meningeal AVF can be treated by several methods. The principle of treatment is the closure of the fistulous portion. Proximal occlusion may result in retrograde filling of the fistula from the distal portion of the occluded artery. We first planned to insert coils into the middle meningeal artery across the fistula, but the introduction of the catheter into the distal portion of the artery could not be achieved. Glue injection, such as n-butyl cyanoacrylate, was also considered but control is difficult so the glue may migrate into the retinal artery via the collateral pathway. We judged that particle embolization was the safest and most effective method to obliterate the fistula as well as the feeding pedicles to the meningioma. PVA particles of 250 to 355 μm size were chosen as the embolic agent because the expected size of the fistula was 400 μm judging from the size of the guide wire. This size of particle is supposed not to pass through the collateral pathway to the retinal artery.

The microcatheter is usually introduced as close as possible to the meningioma to prevent dangerous migration of particles into collaterals. Embolization can then be performed using smaller PVA particles of 150–250 μm size. This type of embolization usually causes massive necrosis in meningiomas and makes internal decompression very easy for large meningiomas. However, introduction of the microcatheter beyond the sharp bend in the sphenoidal portion should not be attempted because of the danger of vessel perforation. Embolization of the meningioma is usually easier and safer than that of arteriovenous malformations or aneurysms. However, this type of rare complication due to vessel perforation is possible during the embolization of meningiomas.

**References**

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