Middle Cerebral-Anterior Cerebral-Radial Artery Interposition Graft Bypass for Proximal Anterior Cerebral Artery Aneurysm
—Case Report—

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Abstract

A 74-year-old man underwent pterional craniotomy to treat a left proximal anterior cerebral artery (ACA) aneurysm. The orifice of the aneurysm was located at the origin of the proximal segment of the ACA, and the right A1 segment of ACA was hypoplastic. After failed attempts at neck plasty with fenestrated clips, trapping and bypass were performed. Superficial temporal to left frontopolar artery bypass was performed to secure minimal blood supply. The radial artery (RA) was then harvested, and middle cerebral artery (MCA) to A1 segment of the ACA bypass was performed using the RA interposition graft. Trapping of the aneurysm was successfully achieved without ischemic event. Intracranial-intracranial bypass has been employed in the treatment of complex cerebral aneurysm in an increasing number of selected patients. The present case shows that MCA-ACA-RA interposition graft bypass is an effective procedure to provide blood supply to the ACA territory if a proximal A1 lesion requires trapping with incompetent contralateral A1.

Key words: cerebral aneurysm, clipping, extracranial-intracranial bypass, intracranial-intracranial bypass, radial artery graft

Introduction

Cerebrovascular anastomosis has evolved from the treatment of ischemic cerebrovascular disease to the treatment of complex cerebral aneurysms.1–12) In the majority of cases, procedures are performed using an extracranial artery as a donor artery with or without interposition graft (extracranial-intracranial bypass).1,4,5,7,9–11) We encountered a case in which intracranial-intracranial bypass appeared preferable, given the anatomical configuration and operative approach employed, which may support the concept that intracranial-intracranial bypass may represent an advanced form of vascular reconstruction that is effective in selected patients.8)

Case Report

A 74-year-old man was referred to our department after incidental discovery of a left internal carotid artery (ICA) bifurcation aneurysm on magnetic resonance (MR) angiography (Fig. 1). Angiography revealed a left ICA bifurcation aneurysm. The orifice of the aneurysm neck was located at the origin of the left anterior cerebral artery (ACA), so could be considered a proximal ACA aneurysm (Fig. 1). The left A1 segment supplied the bilateral ACAs, but the right A1 segment was invisible on right carotid angiography. MR imaging revealed an aneurysm located at the interpeduncular fossa. We planned direct neck clipping from a pterional approach, but intraoperatively found that the aneurysm wall near the neck was sclerotic and thick (Fig. 2A). The aneurysm body was adherent to the optic tract medially, to the oculomotor nerve, superior...
Intraoperative observation confirmed the hypoplastic right A1 segment, so vascular reconstruction was necessary prior to aneurysm trapping. First the superficial temporal artery (STA) was dissected from the scalp, but the length and caliber were insufficient for STA-A1 bypass. Therefore, STA-left frontopolar artery bypass was performed as a precautionary blood conduit into the ACA territory (Fig. 2B). The radial artery (RA) was harvested, and anastomosis performed between the RA and the distal segment of the left A1 segment. Subsequently anastomosis was performed between the other end of the RA and the inferior trunk of the middle cerebral artery (MCA) (Fig. 2C). The aneurysm was successfully trapped after completion of the two bypasses (Fig. 2D).

Postoperative MR imaging revealed no ischemic lesion. Angiography revealed patency of the MCA-RA-ACA bypass (Fig. 3). The patient successfully resumed his previous activities.

**Discussion**

Advances in neurosurgical techniques and technologies have enabled an array of complex cerebral artery bypasses other than STA-MCA bypass.2–4,6,8,9) The present case involved an MCA (M2)-ACA (A1)-RA interposition graft bypass to secure blood flow into the ACA territory. The same bypass procedure was performed for the treatment of complex aneurysm.8)

The present aneurysm had a discrete neck and was located at the origin of the A1 segment of the ACA on angiography. Options of coil embolization or clipping were available, but clipping was the preferred choice in our department. We identified that the right A1 segment of the ACA was hypoplastic and probably incompetent if left A1 trapping was required. However, we did not prepare for extracranial-intracranial bypass such as STA-graft-ACA bypass with an interhemispheric approach. High-flow bypass was required to supply the bilateral ACAs, but the length of the RA graft was insufficient to achieve extracranial-RA-ACA bypass. Selection of a long saphenous vein graft was another potential option, but the probability of graft occlusion would be increased in later periods.7) The orifice of the aneurysm was located at the most proximal part of the ACA (A1); so the distal part of A1 was available as a recipient site. As the contralateral A1 was hypoplastic, prolonged clamp time could have had significantly deleterious effects. We avoided this problem by performing STA-frontopolar artery bypass to supply minimal blood flow to the ACA territory during the A1 clamping necessary for anastomosis. This assist bypass was also expected to help reduce ischemic damage in the eventuality that the MCA-RA-ACA bypass failed.

Intracranial-intracranial bypass appears to be evolving as a preferable option for experienced neurosurgeons in the treatment of complex aneurysm.6,8) This procedure eliminates the need to harvest extracranial donor arteries and neck exposure. Using an interposition graft and an intracranial donor site is effective, particularly if the lesion is deep-seated or the need for bypass has not been anticipated. However, we should also be aware that in-
tracranial-intracranial bypass requires the application of highly trained skills in a narrow surgical corridor, with limited vascular mobility and vascular clamping on at least two occasions for durations of about 30 minutes each. Therefore, we still regard intracranial-intracranial bypass as a second choice, instead planning extracranial-intracranial bypass to attack the aneurysm whenever vascular compromise is expected. The anatomical configuration of the aneurysm did not allow the performance of neck plasty using fenestrated clips or in situ bypass such as re-implantation and re-anastomosis.

The application of MCA-ACA-RA interposition graft bypass may be limited to rare cases in which the aneurysm involves the proximal ACA without a competent contralateral A1 segment. The aneurysm may still be assigned to intravascular coil embolization even after failed aneurysm clipping. The present case shows that MCA-ACA-RA interposition graft bypass is an effective procedure to provide blood supply to the ACA territory if a proximal A1 lesion requires trapping with incompetent contralateral A1.

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