Neurologia i Neurochirurgia Polska
Polish Journal of Neurology and Neurosurgery
DOI: 10.5603/pjnns.105806

ISSN: 0028-3843, e-ISSN: 1897-4260

End-to-end reanastomosis for a ruptured middle cerebral artery fusiform aneurysm

Marek Grubhoffer[1, 2], Jiri Fiedler[1, 3]

[1]Department of Neurosurgery, Ceske Budejovice Hospital JSC, Ceske Budejovice, Czech Republic
[2]Department of Neurosurgery, Charles University Faculty of Medicine in Pilsen, University Hospital Pilsen, Pilsen, Czech Republic
[3]Department of Neurosurgery, Masaryk University Faculty of Medicine, Brno, Czech Republic

Keywords: subarachnoid hemorrhage, complex aneurysm, intracranial-to-intracranial bypass, reanastomosis

To the Editors,

Fusiform aneurysm is a rare complex cerebral aneurysm [1]. It involves the vessel wall around the circumference of the artery and is often complicated by an intraluminal thrombus or distal arterial branches. This non-saccular form of aneurysm is often impossible to treat using conventional microsurgical or endovascular methods [2]. Alternative treatments include cerebral bypass surgery. In this case report, we present the use of intracranial-intracranial (IC-IC) bypass for the treatment of ruptured fusiform middle cerebral artery (MCA) aneurysms.

A 62-year-old woman was admitted to a comprehensive stroke center after sudden onset of severe headache, nausea, and photophobia. She was a nonsmoker with a history of arterial hypertension, diabetes, and dyslipidemia. The patient was administered a long-term insulin analogue, oral hypoglycemic drug, antihypertensive drug, and statin.

Her premorbid modified Rankin Scale (mRS) score was 0. She was somnolent with dysarthria and mild left upper extremity paresis on admission. Her National Institutes of Health Stroke Scale score was 3. A non-contrast computed tomography (CT) brain scan (Toshiba, Tokyo, Japan) showed a subarachnoid hemorrhage with a peak in the right Sylvian fissure and intracerebral hemorrhage in the right frontal lobe (Fig. 1A, B). She scored Hunt and Hess grade 2 and Barrow Neurological Institute grade 4. The arterial phase of the CT angiography showed a small intracranial aneurysm of the opercular segment (M3) of the right MCA (Fig. 1C). The interventional radiologist deemed the finding unsuitable for treatment with coiling or a flow diverter due to its distal location, the narrow diameter of the vessel in the M3 segment, and the absence of an aneurysm neck. Based on unanimous agreement among the members of the stroke team, urgent open surgical treatment with possible extra-intracranial (EC-IC) bypass as a back-up plan was indicated.

The parietal branch of the superficial temporal artery was dissected using a right frontotemporal craniotomy approach. After opening the right Sylvian fissure filled with the hematoma, the superior and inferior trunks of the insular segment of the right MCA were identified. The right frontal lobe hematoma was then entered distal to the right MCA branches under the control of intraoperative cranial navigation (Medtronic, Minneapolis, MN, USA). After evacuation, a 5 mm thrombosed fusiform aneurysm of the M3 branch of the superior trunk was observed (Fig. 1D). The aneurysm was untreatable with standard clipping. Temporary closure of the affected artery with clips did not alter the somatosensory and motor-evoked potentials, even after 10 min. The aneurysm was resected radically. However, the cavity after hematoma evacuation and sufficient length of the mobilized proximal and distal M3 stumps provided an ideal situation for re-anastomosis (Fig. 1E). End-to-end microanastomosis was performed using a triangular technique with an interrupted 10-0 polypropylene suture (Fig. 1F, Supplementary Material — Fig. 2). Flow through the patent microanastomosis was verified by the intravenous application of indocyanine green. A lavage IRRAflow catheter

Address for correspondence: Jiri Fiedler, M.D., Ph.D., Department of Neurosurgery, Ceske Budejovice Hospital JSC, Bozeny Nemcove 585/54, Ceske Budejovice, Czech Republic, 37001, tel: +420387876000, e-mail: fiedler.jiri@nemcb.cz
Received: 23.04.2025 Accepted: 15.09.2025 Early publication date: 6.10.2025

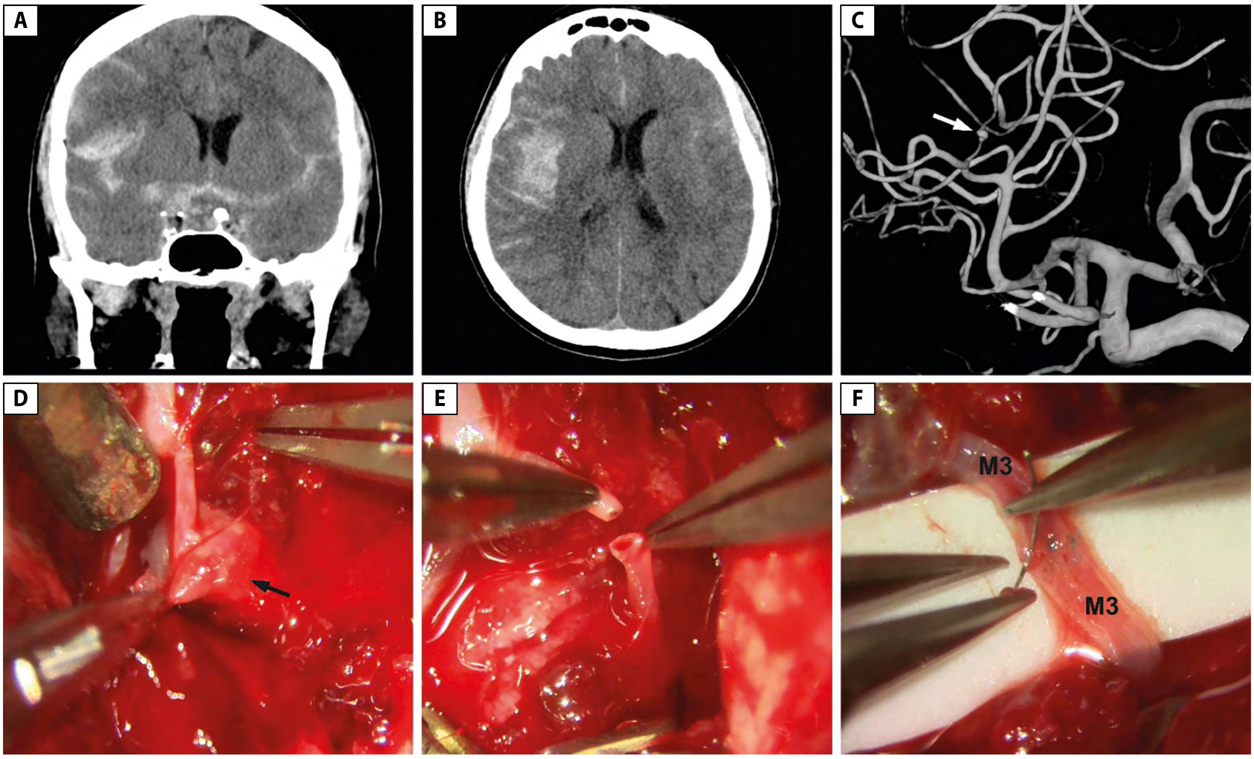

Figure 1. A, B. Subarachnoid hemorrhage and intracerebral hematoma of the right frontal lobe on initial CT; **C.** 3D CTA reconstruction of the RMCA, spastic M3 branch with fusiform aneurysm (white arrow); **D.** Intraoperative view of the fusiform aneurysm dissection (black arrow); **E.** Mobilized proximal and distal M3 stump after fusiform aneurysm resection; **F.** End-to-end microanastomosis of the M3 branch. CT — computed tomography; RMCA — right middle cerebral artery

(IRRAS Inc., San Diego, CA, USA) was temporarily implanted in the intracerebral hemorrhage cavity of the frontal lobe and right Sylvian fissure for irrigation of the subarachnoid space and for intrathecal administration of Ringer's solution with nimodipine for 72 h after surgery (Supplementary Material — Fig. 3). Postoperative CT angiography demonstrated a patent re-anastomosed M3 branch. Quantitative MR angiography using noninvasive optimal vessel analysis software (NOVA, VasSol Inc., River Forest, IL, USA) showed a re-anastomosed M3 branch flow of 34 mL/min at three weeks with no evidence of new ischemia (Supplementary Material — Fig. 4). At three months and one year follow-up, the patient had no neurodeficits, and mRS score was 0.

Reanastomosis (end-to-end anastomosis) with reimplantation (end-to-side anastomosis) and in situ side-to-side anastomosis and intracranial bypass using a vascular graft are representatives of the group of IC-IC bypasses, the third generation of cerebral bypasses [2, 3]. These bypasses could be a solution for challenging cerebrovascular lesions that cannot be safely treated with conventional surgical or endovascular methods, such as coiling or flow diverter, and where occlusion of the parent artery poses a risk of significant ischemia. The shape and size of the aneurysm, suitability of the donor artery, anatomy of the surrounding vascular structures, and depth of the surgical corridor determine the strategy and choice of bypass type [2]. Compared with EC-IC bypasses, this generation of bypasses offers several advantages. There is no need for a neck incision with additional anastomosis to the carotid artery and tunnelling of the vascular graft in the subcutaneous tissue of the head and neck. The risk of wound-healing complications was also reduced. Thus, the risk of bypass occlusion during external compression is eliminated. A significantly shorter graft length is required when a vascular graft was necessary [2]. However, the disadvantage is that IC-IC bypasses are technically more complex. The surgical corridor is narrow and deep. Cerebral arteries have limited mobility [2]. The procedure demands a high level of technical microsurgical expertise. Essential components of this skill set include the ability to perform microsuture techniques in deep corridors using long microinstruments and to minimize the temporary occlusion time of the parent artery, as well as expert anatomical knowledge. The failure of microanastomosis carries a high risk of significant ischemia or bleeding.

Reanastomosis is the reconstruction of arterial stumps by end-to-end anastomosis following complete removal of the aneurysm without using an interposition vascular graft. This procedure works well for small- and medium-sized fusiform aneurysms with single afferent and efferent arteries. This can be performed using running or interrupted sutures. The artery must not be under tension during microsuturing. Otherwise, there is a higher risk of vessel lumen occlusion [3]. The tortuous course of the MCA branches in the insular and opercular segments with 90–180 degree turns provides additional vessel length during mobilization. The branches below the level of the Sylvian fissure have a less tortuous course [3]. After resection of larger aneurysms with a gap > 5 mm, a vascular graft is required. The radial artery, superficial temporal artery, and saphenous vein are most commonly used. It is essential to support cerebral perfusion during surgery by increasing blood pressure by 10–20% of the baseline, maintaining hemodynamic stability, and carefully controlling the arterial occlusion time. Total intravenous anesthesia with propofol and intraoperative neuromonitoring with evoked action potentials are preferred [2].

Intracranial-intracranial bypass is an effective but highly selective treatment option for complex cerebral aneurysms of the anterior cerebral artery, posterior cerebellar artery, MCA, and the apex of the basilar artery. EC-IC bypass is preferred for internal carotid artery aneurysms in the petrous, cavernous, and supraclinoid segments [2, 3]. A fourth-generation bypass combining atypical vessel structures and suturing techniques, or hybrid endovascular-assisted anastomosis, appears to be an option [4, 5].

Article information

Acknowledgements: *Authors would like to thank Editage (www.editage.com) for English language editing.*
Funding: *The study was supported by the Ceske Budejovice Hospital, Czech Republic, project nr. 2023_10.*
Conflict of interests: *None.*

References

1. Diana F, Romoli M, Raz E, et al. Complex intracranial aneurysms: a DELPHI study to define associated characteristics. Acta Neurochirurgica. 2024; 166(1): 294, doi: 10.1007/s00701-024-06182-z, indexed in Pubmed: 38990336.
2. Park SJ, Lee YJ, Kim WB, et al. Intracranial–intracranial bypass strategies for the treatment of complex intracranial aneurysms: anatomical characteristics and surgical intervention. Acta Neurochirurgica. 2024; 166(1): 42, doi: 10.1007/s00701-024-05945-y, indexed in Pubmed: 38280083.
3. Lawton M. Seven Bypasses: Tenets and techniques for revascularization. Thieme, New York 2018.
4. Frisoli FA, Catapano JS, Baranoski JF, et al. The middle communicating artery: a novel fourth-generation bypass for revascularizing trapped middle cerebral artery bifurcation aneurysms in 2 cases. Journal of Neurosurgery. 2021; 134(6): 1879–1886, doi: 10.3171/2020.4.jns193412, indexed in Pubmed: 32650313.
5. Cenzato M, Dones F, Fratianni A, et al. A minimally invasive approach for giant middle cerebral artery thrombosed aneurysms treatment. J Neurosurg Sci. 2022; 66(5): 440–446, doi: 10.23736/S0390-5616.19.04768-4, indexed in Pubmed: 31680506.