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Cerebrovascular High-Flow Bypass for Skull Base Pathologies

Wanibuchi M* and Mikuni N

Department of Neurosurgery, Sapporo Medical University School of Medicine, Japan

Cerebral bypass surgery is classified as low-flow and high-flow. The low-flow bypass includes the superficial temporal artery (STA) –middle cerebral artery (MCA) anastomosis, first performed by Dr. Yasargil [1] for a patient with a carotid artery occlusion. It is estimated that the low-flow donor vessels provide less than 50 mL/min blood flow to the cerebral artery [2]. This low-flow bypass is performed for patients harboring brain ischemia and alterations in brain metabolism due to impaired blood flow. On the other hand, the high-flow bypass is a more reliable procedure for acquiring enough flow volume if a large parent artery is sacrificed. The primary candidate donors of the high-flow graft, providing a blood flow greater than 50 mL/min, are the saphenous vein (SV) and the radial artery (RA). The first high-flow bypass using the SV graft from the common carotid artery to the intracranial ICA was performed by Lougheed et al. [3]. This extracranial–intracranial (EC–IC) high-flow bypass using the SV graft has been applied for the treatment of unclipable aneurysms. Dr. Sundt et al. [4] pioneered this procedure, which was also developed by Dr. Spetzler et al. and Dr. Sekhar et al. [2,4-16]. The EC–IC bypass technique was adapted for the IC–IC bypass, such as the intracranial petrous–to–supraclinoid ICA bypass. The SV graft is extracted from the upper or lower leg, depending on the uniform caliber of the SV with respect to the recipient artery. The SV graft is easy to harvest and the scar of the skin incision may be hidden by the trousers or skirt. The RA graft is easy to identify because the pulsation of the RA is felt at the lateral side of the wrist and the medial side of the cubital fossa. In addition, kinking or torsion of the RA does not tend to occur due to its wall thickness composing of 3 layers.

The majority of the intracranial skull base lesions requiring the high-flow bypass consist of giant paraclinoid ICA aneurysms and cavernous meningiomas [11,13,17-19]. The use of high-flow bypass for those pathologies has gradually declined since alternative treatments including tube stent or radiosurgery have been developed. A balloon test occlusion (BTO) is pre-operatively performed to assess the requirements of the bypass procedure. It is evident that the BTO has become an important reference of diagnosis. The BTO should be performed with neurological monitoring assistance, and cerebral blood flow analysis using perfusion computed tomography scan or single-photon emission computed tomography. However, BTO is not definite to judge the requirement of bypass grafts because the method leads to false negative case [20]. The patency of the high-flow graft was more than 95% [2]. The morbidity and mortality rates accompanying the surgery were 7% and 2%, respectively [2,17]. Development of physiological evaluation of vascular reserve and refinement of microsurgical techniques and devices has allowed the surgical procedure to be relatively safe. Nonetheless, prognosis of the original pathologies and the indication of the high-flow bypass surgery should be carefully considered.

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***Corresponding author:** Masahiko Wanibuchi, Department of Neurosurgery, Sapporo Medical University School of Medicine, South 1, West 16 Chuo-ku, Sapporo Hokkaido 060-8543, Japan, Tel: +81-11-611-2111; Fax: +81-11-614-1662; E-mail: wanibuti@sapmed.ac.jp

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