Efficacy of Early Superficial Temporal Artery–Middle Cerebral Artery Double Anastomoses for Atherosclerotic Occlusion in Patients with Progressing Stroke

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Background: We investigated the efficacy of early superficial temporal artery–middle cerebral artery (STA–MCA) double anastomoses for patients with progressing stroke due to atherosclerotic occlusion. *Materials and Methods:* Nine consecutive patients who underwent early STA–MCA double anastomoses were enrolled. All patients presented with progressing stroke despite maximal medical treatment. Cerebral blood flow in 7 patients was analyzed by single-photon emission tomography. Clinical outcomes were investigated postoperatively, and we evaluated the utility of early STA–MCA double anastomoses. *Results:* Nine patients in the present study included those with middle cerebral artery occlusion (n = 6) and internal carotid artery occlusion (n = 3). The mean age was 58.4 years. Subjects comprised 1 female (11.1%) and 8 males (88.9%). The cause was low perfusion ischemia due to atherosclerotic occlusion with a small infarct. The mean regional cerebral blood flow (rCBF) ratio in the middle cerebral artery territory compared to the normal side was 69.6 ± 5.3%. The duration from onset to surgery was 1-8 days (median, 3.11 days). All patients underwent early STA–MCA double anastomoses, and no reperfusion-induced hemorrhage occurred. All of them slowly achieved obvious remission compared to symptoms on admission and achieved a good functional outcome. *Conclusions:* Early STA–MCA double anastomoses were safe and effective, and early revascularization resulted in rapid neurological improvement. We recommend this procedure for patients with progressive ischemia due to main trunk artery occlusion, when the rCBF flow ratio with the normal side was 70 ± 10%, even at the subacute stage. **Key Words:** Main trunk artery occlusion for atherosclerosis—early superficial temporal artery–middle cerebral artery double anastomoses—progressing stroke—subacute stage.

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Compliance with ethical standards: The clinical study of the following studies was approved by the Ethics Committee for Clinical Research of Ehime Prefectural Central Hospital, and informed consent was obtained from each patient before initiating the study. All of the authors are aware of and agree to the content of the manuscript and to being listed as an author on the manuscript.

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Introduction

Extracranial–intracranial (EC-IC) arterial bypass procedures, for example, superficial temporal artery–middle cerebral artery (STA–MCA) anastomosis, have been widely used to augment cerebral blood flow (CBF) and have also been shown to be effective in the treatment of several cerebrovascular diseases, including ischemic atherosclerotic occlusive disease that is refractory to optimal medical treatment.[1,2] However, indications for this procedure have not been thoroughly investigated. In addition, the timing of this surgery for acute ischemic stroke has not been established because of conflicting opinions regarding issues such as reperfusion injury and various perioperative complications. Nevertheless, in previous reports, the clinical outcomes of occasional STA–MCA anastomosis performed at the subacute stage of progressing stroke have been good.[3,4] The purpose of this retrospective study was to evaluate the efficacy and safety of early STA–MCA bypass in patients with progressing stroke due to atherosclerotic occlusion in the subacute stroke stage.

Materials and Methods

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The present study was approved by the local ethics committee for clinical research.

We retrospectively reviewed the records of all patients who had undergone early EC-IC bypass (STA–MCA double anastomoses) procedures performed by a single neurosurgeon (Kanehisa Kohno) at Ehime Prefectural Central Hospital between April 1998 and December 2012. We identified 9 patients who underwent emergency revascularization surgery to treat acute cerebral ischemia with progressing stroke due to atherosclerotic occlusion in the subacute stroke stage despite maximal medical therapy. In every case, there was no embolic background, so it was evident that endovascular options were believed either to be contraindicated or to carry a much higher risk than surgical revascularization. Preoperative magnetic resonance imaging (MRI) was performed on all of the patients, and CBF analysis using single-photon emission computed tomography (SPECT) was enforced as far as we can. All patients demonstrated worsening symptoms and evidence of progressive ischemic injury on diffusion-weighted image/MRI studies despite aggressive medical therapy consisting of induced arterial hypertension, fluid resuscitation, anticoagulation (continuous intravenous infusion of a weight-based protocol dose of heparin), and antiplatelet therapy (intravenous administration of ozagrel sodium within 48 hours of admission with a dosage of 80 mg twice a day), so that they were offered the option of continuation of the medical treatment or emergency surgical revascularization, and they underwent STA–MCA double anastomoses. In all cases, we performed a simple and traditional STA–MCA double bypass surgery and did not attempt to open into the depths of the sylvian fissure or perform a so-called high-flow bypass. Additionally, we measured the middle cerebral artery pressure (MCAP) and MCAP/mean systemic blood pressure (MSBP) ratio during the operation. We were particularly careful to avoid hypotension or hyperventilation in this group of the patients, typically opting for mild induced hypertension to maintain a systolic blood pressure above 120 mm Hg during surgery. After surgery, the patients were admitted into the intensive care unit for careful monitoring of blood pressure control, avoiding hypertension that might cause hemorrhaging from chronically dilated intraparenchymal vessels and epidural and subdural hematomas. We strictly maintained the patients' systolic blood pressure below 150 mm Hg. All patients were maintained on oral aspirin therapy at a dose of 100 mg/day or clopidogrel at a dose of 75 mg/day. Postoperative MRI and SPECT study was performed within a week after surgery. Neurological examinations were assessed on admission, immediately before surgery, at discharge (30 days after surgery), and 1 year later.

Informed consent regarding the surgical procedure and potential risks of STA–MCA double anastomoses was obtained from all individual participants enrolled in the present study.

Outcome Evaluation

We evaluated the efficacy and safety of early STA–MCA double anastomoses on the basis of clinical outcomes, postoperative complications, and hemodynamic changes. The reviewed clinical outcomes included the National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) scores (on admission, preoperatively, at discharge, and 1 year later). A good functional outcome was defined as an mRS score of 0-2. We focused our literature search on 3 categories: the time interval between symptom onset and bypass surgery, the clinical outcomes of patients with hemodynamic failure who were treated with STA–MCA bypass, and the postoperative complications such as hyperperfusion-induced hemorrhage or newly developed infarction.

Statistical Methods

Statistical analysis was performed using Fisher's exact test for categorical variables and analysis of variance for continuous variables. Two-tailed tests were performed for each scenario, and the significance level was set at a P value less than .05. All analyses were performed