Superficial Temporal Artery-Middle Cerebral Artery Anastomosis for Internal Carotid Artery Occlusion by Subacute In-Stent Thrombosis after Carotid Artery Stenting

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Alternative to carotid endarterectomy, carotid artery stenting (CAS) can be performed for symptomatic severe stenosis of internal carotid artery, especially for high-risk patients. Among several complications after CAS, subacute in-stent thrombosis is rare but important, because patient’s condition can deteriorate rapidly. Subacute in-stent thrombosis with carotid artery occlusion can be managed by superficial temporal artery-middle cerebral artery (STA-MCA) anastomosis. We report two cases of STA-MCA anastomosis for internal carotid artery occlusion by subacute in-stent thrombosis after CAS.

Key Words: Carotid artery stenting (CAS) - Subacute in-stent thrombosis - Superficial temporal artery-middle cerebral artery (STA-MCA) anastomosis.
symptom was 16 points which indicated that the symptoms were progressed. Proximal ICA occlusion was identified in neck angio CT (Fig. 2C). Intravenous tissue plasminogen activator and Intrarterial thrombolysis were failed (Fig. 2D-F). Diffusion-perfusion mismatch was seen on perfusion CT image. Therefore, urgent STA-MCA anastomosis was performed (Fig. 2G, H). Aspirin and clopidogrel resistance test showed that the patient was resistant to both drugs. Triple antiplatelet medication therapy was started. The symptoms improved, but right hemiparesis was remained. Three months after the surgery, his mRS score was 3 points.

**DISCUSSION**

In-stent thrombosis is a stressful situation to doctors and is also a life-threatening moment to patients. Prompt diagnosis and reperfusion is vital to limit cerebral ischemia10). However, the incidence, pathophysiology and treatment of subacute in-stent thrombosis have hardly been reported in current interventional neurology literature to date. Therefore, the authors consulted interventional cardiology literature. Cardiologists defined subacute thrombosis as occlusion at the stented site within the first 28 days after the procedure12). Several theories have been suggested to explain the reasons for in-stent thrombosis. A low response or non-response to platelet inhibitors (e.g., aspirin or clopidogrel), atherosclerotic stenosis plaque rupture with the release of intrinsic factors promoting thrombosis in patients, inappropriate pretreatments, dissection at the uncovered stent portion, and a high degree of residual stenosis are included in these theories6). The rate of in-stent thrombosis is known to be seven times higher in intracranial stenting than coronary artery stenting. This might be due to the difference in the size of vessel lumen or perfusion pressure, ignorance of some subacute coronary stent thrombosis, and specific differences in the vessel wall regarding platelet adherence12). Van Laanen et al.13) suggested advanced age, female gender, implantation of multiple stents, prior revascularization treatment, suboptimal result with residual stenosis, elevated balloon angioplasty were performed. After 5 month, aggravated left proximal ICA stenosis (72%) was found during the follow-up (Fig. 2A). Left CAS and balloon angioplasty were also performed (Fig. 2B). He was discharged after starting dual antiplatelet medication. Four days after CAS, sudden right hemiparesis, dysarthria, and right facial palsy were noted. The patient was brought to the emergency department. NIHSS score at the admission was 2 points and NIHSS score in 6 hours from onset of symptom was 16 points which indicated that the symptoms were progressed.
postprocedural serum levels of acute-phase reactants, asymptomatic lesion, and use of balloon expandable stents as the predictors of in-stent restenosis after CAS. Watarai et al.\(^{14}\) reported that the occurrence rate of acute or subacute in-stent thrombosis among 23 cases of CAS was 43.5% and the problem was mostly resolved within 12 weeks owing to endogenous thrombolysis. They also reported lengths of stenosis and stent lengths as the risk factors of in-stent thrombosis. There was a relatively high prevalence of antiplatelet drug resistance in patients with atherosclerotic cerebrovascular disease\(^{12}\). Furthermore, acute in-stent thrombosis was more frequently seen in the antiplatelet drug resistant group\(^{12}\). Although in-stent thrombosis do not always occur in antiplatelet drug resistant patients, it is thought to be related\(^{10}\). Feher et al.\(^{4}\) reported that aspirin/clopidogrel resistance seemed to be associated with poor clinical outcomes. In neurointervention, the guideline of medications has not yet been clearly established. However, antiplatelet drug resistance tests and the adjustment of antiplatelet drug medication are widely accepted and used. In addition to the conventional dual antiplatelet drug therapy (aspirin 100 mg+clopidogrel 75 mg), an increase of clopidogrel dosage or an addition of other medicine might be necessary.

Carotid artery occlusion may occur after carotid artery stenting. In our cases, uncontrollable hemodynamic infarction was occurred. STA-MCA anastomosis was performed. After intensive care, the patient conditions were stabilized but neurologic sequelae were remained. These results implied a benefit of revascularization surgery.

According to the American Stroke Association Guideline for the Early Management of Adults With Ischemic Stroke, EC-IC bypass did not help patients with acute cerebral infarction because of intracranial hemorrhage\(^{9}\). However, the guideline introduced the favorable results with emergency bypass procedures\(^{8,10}\). Owing to the recent development of diagnostic techniques, the mechanisms of symptom development or fluctuation have been understood and this has helped the selection of candidates who likely to benefit from urgent reperfusion procedures. In fact, research results regarding this have been published. A JET study reported that EC-IC bypass surgery reduced the incidence of major stroke or death in the 2 years after the surgery\(^{9}\). Jeffree and Stoodley\(^{7}\) reported that the stroke incident rate after bypass surgery was 8% per year among patients with symptomatic carotid occlusion and the incident rate was 18% per year among patients who were waiting.
for the surgery. Hwang et al.\(^5\) described STA-MCA anastomosis as low flow bypass and reported that it had no complications associated with reperfusion compared with high flow bypass. Therefore, STA-MCA anastomosis may be beneficial to patients with acute ischemic stroke or stroke in progress in whom intra-arterial thrombolysis is not possible.

**CONCLUSION**

We report two cases of STA-MCA anastomosis for internal carotid artery occlusion by subacute in-stent thrombosis after carotid artery stenting.

**References**


