The Safety of Carotid Artery Stenting for Patients in the Acute Poststroke Phase

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Background: The efficacy of carotid artery stenting (CAS) for patients in the acute poststroke phase has not been established. We investigated the outcome of CAS for patients with symptomatic internal carotid artery (ICA) stenosis in the acute poststroke phase. *Methods:* We performed a retrospective analysis of all patients who underwent CAS for symptomatic ICA stenosis in our institution. Patients in whom the time interval between neurological deterioration and the CAS procedure was less than 3 days were included in the early group, and the other patients were included in the delayed group. Perioperative complications including major adverse events (MAEs) were compared between the early and the delayed groups. *Results:* One hundred five patients were included in the study. Forty patients were assigned to the early group and 65 patients were assigned to the delayed group. The overall MAE rate was 4.8%. There was no significant increase in the perioperative MAE in the early group compared with the delayed group (early group 2.5% versus delayed group 6.5%, $P = .65$). In the early group, 25 of 40 patients (62.5%) were functionally independent (modified Rankin scale [mRS] score of 0-2) at discharge. Significant differences between the independent patients and the disabled patients (mRS score of 3-6) included age (independent 72 versus disabled 79, $P < .01$) and prevalence of transient ischemic attack (36.0% versus .0%, $P = .02$). *Conclusions:* CAS performed within 3 days from the last ischemic event did not increase the risk of perioperative complication. Early CAS may be a useful option for the treatment of symptomatic carotid artery stenosis. **Key Words:** Complication—emergency—intervention—ischemic stroke—urgent care.

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Ethical approval and informed consent: All patients or their representatives signed an informed consent. This study was performed in accordance with the Helsinki Declaration and was approved by the internal review board.

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Introduction

Randomized trials have shown that carotid endarterectomy (CEA) is beneficial for recently symptomatic severe carotid stenosis.[1-3] The benefit of CEA is highly dependent on the time interval since the ischemic event.[4,5] Several large studies have reported the safety of early CEA.[6-8]

During the past decade, carotid artery stenting (CAS) has become an additional treatment option for carotid artery stenosis.[9,10] Recently developed embolic protection devices (EPDs) have improved CAS outcomes, and endovascular interventionists are becoming familiar with the procedure.[11-13] Although several studies have reported the efficacy of CAS for patients with recent ischemic stroke,[14-17] the efficacy of early CAS has not been established. In the present study, we investigated the outcome of early CAS for patients with ischemic stroke due to extracranial internal carotid artery (ICA) stenosis.

Methods

Inclusion and Exclusion Criteria

We performed a retrospective analysis of all patients who underwent CAS for symptomatic ICA stenosis at our institution between April 2012 and July 2016. The patients were divided into an early group and a delayed group based on the time interval between symptom onset or neurological deterioration and CAS procedure. Patients in whom the interval was less than 3 days were included in the early group, and patients in whom the interval was more than 4 days were included in the delayed group. Patients with asymptomatic lesions, intracranial ICA stenosis, chronic total occlusion, in-stent restenosis after CAS, iatrogenic carotid artery dissection, and tandem lesions that required additional intervention including thrombectomy were excluded from the study.

The diagnosis of carotid artery stenosis was based on carotid duplex or selective carotid angiography. The degree of stenosis was determined by the North American Symptomatic Carotid Endarterectomy Trial (NASCET) method. All data were collected retrospectively from medical records. All patients or their representatives signed an informed consent before the procedure. The present study was approved by the internal review board of our institution.

Evaluation of the Atherosclerotic Plaque

The vulnerability of the carotid artery plaque was evaluated by 3.0-T magnetic resonance imaging (MRI) (GE SIGNA Scanner; General Electric Healthcare Life Sciences, Little Chalfont, UK) at our institution. MRI sequences included time of flight and T1-weighted axial and long-axis images of the carotid arteries.

Vulnerable plaques can be detected as high–signal-intensity regions on carotid T1-weighted MRI.[18,19] Signal intensities of plaques and of the proximal sternocleidomastoid muscle on T1-weighted axial MRI were measured. The signal intensity ratio (SIR) was defined as the signal intensity of the carotid plaque divided by that of the sternocleidomastoid muscle.[20,21]

Perioperative Care with Strict Management

All patients with unstable neurological symptoms, including stroke-in-evolution and crescendo transient ischemic attack (TIA), were strictly managed to minimize neurological deficits and risk of perioperative complications. Optimal medical therapy was immediately initiated in all patients. Patients were carefully observed in a high-care unit to quickly detect symptom deterioration. In those patients who were not at high risk of bleeding, dual antiplatelet therapy was initiated upon admission, including aspirin, clopidogrel, and cilostazol. If neurological symptoms deteriorated, emergency CAS was performed as soon as possible to minimize cerebral injury. Patients without neurological deterioration underwent elective intervention after the acute stroke phase.

All CAS procedures were performed with EPDs. Because recent studies have reported that the combination of distal-filter protection and the flow-reversal method, termed "dual protection," is a safe and effective way to prevent distal embolization,[22-24] this was our method of choice. If a patient was not suitable for dual protection, a different EPD was selected, including distal-filter alone or proximal protection alone.

To detect perioperative intracranial hemorrhage, brain computed tomography was performed immediately after CAS. In the confirmed absence of hemorrhage, patients were transferred to a high-care unit for overnight observation. Blood pressure was intensively lowered after stenting to prevent hyperperfusion syndrome. In the absence of contraindications, diffusion-weighted imaging (DWI) was performed several days after the procedure to detect any embolization caused by the CAS procedure.

CAS Procedure

All procedures were performed with local anesthesia. A 9-French balloon-guided catheter was introduced via the transfemoral approach. All patients were administered systematic heparin after the introduction of the sheath. The activating clotting time was maintained at more than 250 seconds during the procedure. The balloon-guided catheter "Optimo" (Tokai Medical Product, Aichi, Japan) was used to occlude the common carotid artery (CCA), and a Carotid GuardWire PS (Medtronic, Boston, MA) was introduced into the external carotid artery (ECA) to occlude its proximal portion. After the occlusion of the ECA, the Optimo guiding balloon was inflated to occlude the CCA and to begin the flow reversal. A filter-wire EZ (Boston Scientific, Natick, MA) was carefully crossed through the stenotic lesion and the filter was opened at the prepetrous portion of the ICA. Blood was aspirated