Surgical Outcomes for Cervical Carotid Artery Stenosis: Treatment Strategy for Bilateral Cervical Carotid Artery Stenosis

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Background: Carotid endarterectomy (CEA) and carotid stenting (CAS) are beneficial procedures for patients with high-grade cervical carotid stenosis. However, it is sometimes difficult to manage patients with bilateral carotid stenosis. To decide the treatment strategy, one of the most important questions is whether contralateral stenosis increases the risk of patients undergoing CEA. *Methods:* This retrospective study included 201 patients with carotid stenosis who underwent a total of 219 consecutive procedures (CEA 189/CAS 30). We retrospectively analyzed outcomes in patients with carotid stenosis who were treated with either CEA or CAS and evaluated whether or not contralateral lesions increases the risk of patients undergoing CEA or CAS. Furthermore, we retrospectively verified our treatment strategy for bilateral carotid stenosis. *Results:* The incidences of perioperative complications were 5.3% in the CEA patients and 6.7% in the CAS patients, respectively. There was no significant difference between these 2 groups. The existences of contralateral occlusion and/or contralateral stenosis were not associated with perioperative complications in both the groups. There were 32 patients with bilateral severe carotid stenosis (>50%). Of those, 13 patients underwent bilateral revascularizations; CEA followed by CEA in 8, CEA followed by CAS in 3, CAS followed by CEA + coronary artery bpass grafting in 1, and CAS followed by CAS in 1. *Conclusions:* Our date showed that the existence of contralateral carotid lesion was not associated with perioperative complications, and most of our cases with bilateral carotid stenosis initially underwent CEA. **Key Words:** Carotid endareterectomy—bilateral carotid stenosis—carotid stenting—risk factors.

Introduction

Carotid endarterectomy (CEA) and carotid stenting (CAS) are beneficial procedures for patients with high-grade cervical carotid stenosis.[1-4] Procedural selection should be determined by age, general condition, symptoms, plaque characteristics, anatomic situation, hemodynamic state, and other factors. In fact, radiation-induced carotid stenosis and restenosis after CEA are considered as a high risk for CEA, and CAS is usually performed on those patients.[5-7] On the contrary, one of the remaining issues of CAS is the relatively higher incidence of ipsilateral ischemic lesions after the

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There is no conflict of interest to report.

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procedure, even under embolic protection.[8] Despite neurologic protection during the procedure, there have been several reports about delayed plaque protrusion after CAS, especially in the patients with carotid vulnerable plaque.[9-11] Therefore, CAS is associated with a higher procedural risk of stroke than CEA in symptomatic patients and in elderly patients,[12,13] thus making CEA more suitable for these lesions. Recently, an appropriate procedural selection has been making the overall outcome of carotid artery reconstruction improve as a result of complement to each other.

However, it is sometimes difficult to manage patients with bilateral carotid stenosis. Its treatment strategy is complex, and there are several possible approaches that have yet to be decided, which side to treat first, which procedure to perform, and so forth. To decide the treatment strategy, one of the most important questions is whether contralateral stenosis (CCS) increases the risk of patients undergoing CEA. There have been a few reports regarding the perioperative risks to the patients with contralateral internal carotid artery (ICA) severe stenosis, and these have resulted in conflicting results.[9,10]

Therefore, in our retrospective study, we analyzed outcomes in patients with carotid stenosis that were treated with either CEA or CAS and evaluate whether or not contralateral lesions increases the risk of patients undergoing CEA or CAS. Furthermore, we retrospectively verified our treatment strategy for bilateral carotid stenosis.

Patients and Methods

Patients

This retrospective study included 201 patients with carotid stenosis who underwent a total of 219 consecutive procedures (both CEA and CAS) at Hokkaido University Hospital and its affinitive hospitals between January 2007 and April 2014. This study group comprised 177 males and 24 females with a mean age of 70.0 years (range, 49-85 years). CEA and CAS were performed for 189 and 30 lesions, respectively. All participants provided written informed consent.

On the basis of previous studies, CEA was principally the first choice for reconstructive treatment although patients who experienced restenosis after CEA, radiation-induced carotid stenosis, or medical complications intolerable for general anesthesia underwent CAS.

Among them, 13 patients had contralateral carotid occlusion (CCO), and 32 patients had bilateral severe carotid stenosis (>50%). In these 32 patients with bilateral severe carotid stenosis, 13 patients underwent bilateral carotid reconstructions. For those patients, we retrospectively verified our treatment strategy for bilateral carotid stenosis.

Clinical Characteristics

Clinical data were collected from the patients' medical records. In this study, the authors used the following factors: age, gender, stenosis degree, plaque characteristics, contralateral lesion, hypertension (HT) (systolic blood pressure >140 mm Hg or diastolic blood pressure >90 mm Hg) or current treatment status, diabetes mellitus (DM; hemoglobin A_{1C}, 6.5) or current treatment status, hyperlipidemia (HL; serum low-density lipoprotein cholesterol >140 mg/dL) or current treatment status, and ischemic heart disease (IHD) or current treatment status. All patients underwent preoperative screening for IHD to prevent perioperative cardiac complications. We then consulted the cardiology department and, if required, performed a treadmill stress electrography and coronary digital subtraction angiography. Regardless of the presence or the absence of symptoms of angina pectoris, the patients with severe stenosis of the coronary artery were regarded as having IHD.

The degree of stenosis was determined according to the North American Symptomatic Carotid Endarterectomy Trial criteria[1] and estimated using 3-dimensional computed tomography angiography or digital subtraction angiography. CCS was defined as a presence of more than 50% stenosis of contralateral ICA.

Magnetic resonance imaging (MRI) or carotid ultrasonography was performed for the evaluation of plaque characteristics. Black-blood MRI used a fat-suppressed T1-weighted fast spin-echo sequence. The MR signal intensity of the carotid plaque in the area with the highest rate of stenosis was classified as low or high compared with the intensity of the ipsilateral sternocleidomastoid muscle. Ultrasonography was also performed on the patients to evaluate carotid plaque characteristics. Carotid plaque was defined as an arterial wall lesion that projected into the vessel lumen. The plaque was qualitatively assessed as being predominantly (>50% area of plaque images) low (blood-like echogenicity), intermediate, or high (intensely bright echogenicity).

CEA Procedures

All CEAs were performed under general anesthesia. Carotid shunts with intraoperative monitors of near infrared spectroscopy and sensory-evoked potential or motor-evoked potential were used as a matter of routine. CEA was performed as previously described.[14] Briefly, the carotid bifurcation was dissected, and then, an intravenous bolus of heparin (3000 units) was administered before carotid clamping. For precise and delicate plaque dissection, we routinely insert internal shunt tubes. The superior thyroid and external carotid arteries were occluded with aneurysmal clips. The common carotid artery and ICA were occluded with vascular clamps. Arteriotomy was subsequently performed, and a 3-way internal shunt tube (Furui 3.0 or 3.5) was inserted in all