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PERIPHERAL

Predictors for Successful Endovascular Intervention in Chronic Carotid Artery Total Occlusion

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ABSTRACT

OBJECTIVES This study sought to determine predictors for successful endovascular treatment in patients with chronic carotid artery occlusion (CAO).

BACKGROUND Endovascular recanalization in patients with chronic CAO has been reported to be feasible, but technically challenging.

METHODS Endovascular attempts in 138 consecutive chronic CAO patients with impaired ipsilateral hemisphere perfusion were reviewed. We analyzed potential variables including epidemiology, symptomatology, angiographic morphology, and interventional techniques in relation to the technical success.

RESULTS The technical success rate was 61.6%. Multivariate analysis showed absence of prior neurologic event (odds ratio [OR]: 0.27; 95% confidence interval [CI]: 0.10 to 0.76), nontapered stump (OR: 0.18; 95% CI: 0.05 to 0.67), distal internal carotid artery (ICA) reconstitution via contralateral injection (OR: 0.19; 95% CI: 0.05 to 0.75), and distal ICA reconstitution at communicating or ophthalmic segments (OR:0.12; 95% CI: 0.04 to 0.36) to be independent factors associated with lower technical success. Point scores were assigned proportional to model coefficients, and technical success rates were >80% and <40% in patients with scores of ≤1 and ≥4, respectively. The c-indexes for this score system in predicting technical success was 0.820 (95% CI: 0.748 to 0.892; $p < 0.001$) with a sensitivity of 84.7% and a specificity of 67.9%.

CONCLUSIONS Absence of prior neurologic event, nontapered stump, distal ICA reconstitution via contralateral injection, and distal ICA reconstitution at communicating or ophthalmic segments were identified as independent negative predictors for technical success in endovascular recanalization for CAO. (J Am Coll Cardiol Intv 2016;9:1825–32)

Carotid artery occlusion (CAO) is associated with a 6% to 20% annual risk of recurrent ipsilateral ischemic stroke despite intensive medical treatment (1,2), and surgical bypass offers no benefit in preventing stroke (3-5). Feasibility and midterm results of endovascular treatment of chronic CAO have been reported (6,7), successful recanalization restores cerebral perfusion and may improve neurocognitive function (8-10). However, CAO recanalization is technically challenging and its potential

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ABBREVIATIONS AND ACRONYMS

CAO = carotid artery occlusion
CCA = common carotid artery
CI = confidence interval
ICA = internal carotid artery
OA = ophthalmic artery
OR = odds ratio

complication may be life threatening. Therefore, the acceptance and dissemination of this procedure has been slow. We present a retrospective analysis of CAO recanalization attempts to identify predictors for technical success; a scoring system was constructed to facilitate better case selection for beginning operators.

METHODS

PATIENTS. We conducted a retrospective analysis of consecutive CAO recanalization attempts from October 2004 to April 2015 in National Taiwan University Hospital and affiliated hospitals. CAO was detected by Doppler ultrasound, computed tomography, magnetic resonance imaging, or conventional angiography. Brain computed tomography perfusion with acetazolamide (Diamox) stress was performed before carotid intervention to document ipsilateral hemisphere perfusion abnormality in all patients, with method as described previously (10). Prior neurologic symptoms were defined as ipsilateral transient ischemic attack or ischemic stroke or amaurosis fugax. The duration from the last neurologic event to intervention was recorded and categorized as ≤6 months, >6 months, or no history of neurologic event before the diagnosis of CAO. Endovascular recanalization attempts were made after obtaining informed consent. Clinical and neurologic data, angiography findings, and interventional results were collected and reviewed by independent neurologist and interventionist. The retrospective review of the clinical information and radiologic records of the patients were approved by the Institutional Review Board at National Taiwan University Hospital.

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ANGIOGRAPHY. Selective cerebral angiography was done via femoral approach before intervention. Pseudo-occlusion was ruled out using criteria described in the literature (11,12). Angiographic criteria of true occlusion were: 1) discontinuation of lumen >5 mm in length; 2) grade 0 Thrombolysis In Cerebral Infarction (TICI) antegrade flow distal to the occlusion; and 3) established collateral filling to the ipsilateral intracranial internal carotid artery (ICA) territory, either via anterior communicating artery, posterior communicating artery, ipsilateral ophthalmic artery (OA), or other brachiocephalic artery branches. Diameter stenosis was calculated using the NASCET (North American Symptomatic Carotid Endarterectomy Trial) method (13).

INTERVENTIONAL TECHNIQUES. All interventions were performed via an 8-F femoral sheath. Aspirin 100 mg and clopidogrel 75 mg daily for at least 7 days were given before the procedure. Heparin was given to maintain activated clotting time within 200 to 250 s. The target common carotid artery (CCA) was engaged with 8-F JR 4 guiding catheter. Intraluminal wiring using coronary guidewires and microcatheters has been described (6) as well as the alternative subintimal tracking with antegrade re-entry technique (14). Wiring was abandoned after 30 minutes of futile effort, consumption of >300 ml of contrast, or when the wire tip is confirmed to be extravascular.

Once wire enters the distal true lumen, the microcatheter was exchanged to a 1.5-mm diameter coronary balloon for pre-dilation. Distal embolic protection device would be deployed if an adequate landing zone can be identified. Properly sized balloon expandable stents (for segments in and above carotid canal) and self-expanding stents (for cervical ICA) were then deployed to scaffold the occlusion. Balloon post-dilation may be done if stent expansion was not adequate. The intervention was considered a technical success if the occlusion segment was stented with final residual diameter stenosis of ≤20%, and establishing grade 3 antegrade TICI flow.

READING OF ANGIOGRAMS. An independent interventionist reviewed the procedural angiograms offline, and morphologic characteristics regarding the stump, occlusion segment, and distal ICA reconstitution were recorded. A stump was present if there was contrast filling within the segment of cervical ICA after it bifurcates from the CCA, proximal to the occluded segment. Stump angulation was measured using CCA as the reference axis at lateral view, and categorized into >45° or ≤45°. It would be designated as >45° for analysis if stump was absent. The occlusion site was categorized as CCA, cervical ICA, or intracranial ICA. Distal carotid visibility was defined as the presence of contrast reconstitution in the ICA distal to the occlusion, either during selective ipsilateral, contralateral, or vertebral injection. The most proximal level of distal carotid artery reconstitution was categorized as at petrous segment or below, cavernous segment, clinoid segment, ophthalmic segment, and communicating segment. Reversed OA flow was defined as the presence of contrast flow in OA with reversed flow direction during ipsilateral injection. The occlusion length was measured from the occlusion site to the distal reconstituted ICA in lateral projection, in straight line ignoring potential curvature of the occluded segment. The occlusion length was categorized as ≤50 or >50 mm. If the distal ICA was not visible, the occlusion length would be designated as >50 mm.