Three-Year Clinical Results of Carotid Artery Stenting in Treating Patients with Contralateral Carotid Artery Occlusion

Jianming Guo,*,† Lianrui Guo, M.D. PhD,*,† Zhu Tong,*,† Zhonggao Wang,*,† Alan Dardik,‡,§ and Yongquan Gu, M.D. PhD*,†

Background: Patients presenting a carotid stenosis and contralateral carotid occlusion (CCO) have been historically considered at high risk of carotid surgical treatment, and there are few data regarding short-term recovery after stenting therapy in patients with CCO. The aim of this study is to evaluate the short-term recovery and safety of stenting for patients with CCO and different subgroup population. *Methods:* We retrospectively reviewed the records of consecutive patients with CCO who were treated with stenting endovascular methods between 2008 and 2014. The postoperative outcomes were analyzed according to age, ischemic symptom, cerebral infarction history, and collateral situation subgroups, respectively. *Results:* Fifty-eight consecutive patients with CCO were treated and 49 (84.5%) completed a 3-year follow-up. There were significant higher stroke, myocardial infarction, or death events in the aged (≥75 years old) group and poor collateral group ($P = .007$ and .0024, respectively). There was no difference in the 3-year primary endpoint incidence between the cerebral ischemia symptom subgroups and cerebral infarction history subgroups. Event-free survival, aged group, and poor collateral group were lower ($P = .007$ and $P = .0024$, respectively). *Conclusions:* Carotid artery stenting (CAS) for patients with common carotid artery is a safe and effective therapy. Factors such as age 75 years or older and poor collateral are associated with a higher 3-year rate of postprocedural stroke, myocardial infarction and death, and lower event-free survival in patients with CCO treated by CAS. Meanwhile, our data do not show a significant impact of cerebral ischemic symptom and cerebral infarction history on clinical outcome of patients with CCO undergoing CAS. **Key Words:** Carotid artery occlusion—stenting—stroke—myocardial infarction—death.

From the *Department of Vascular Surgery, Xuanwu Hospital, Beijing, China; †Capital Medical University, Institute of Vascular Surgery, Capital Medical University, Beijing, China; ‡Section of Vascular Surgery, Yale University, New Haven, Connecticut; and §Vascular Biology and Therapeutics, Yale University School of Medicine, New Haven, Connecticut.

Received July 13, 2017; revision received November 13, 2017; accepted December 12, 2017.

Grant support: This work is supported by the Beijing Municipal Administration of Hospitals Clinical Technology Innovation Program [Grant No. XMLX201610] and Beijing Municipal Administration of Hospitals Climbing Talent Training Program [Grant No. DFL20150801], Beijing Outstanding Talents Project [Grant No. 2016000020124G108] and Beijing Municipal Science and Technology Commission Clinical Features Applied Research Projects [Grant No. Z141107002514063]. These funding sources are not involved in study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

Address correspondence to Yongquan Gu, Department of Vascular Surgery, Xuanwu Hospital, China. E-mail: lianruiguo@sina.com; gu15901598209@aliyun.com.

1052-3057/$ - see front matter

https://doi.org/10.1016/j.jstrokecerebrovasdis.2017.12.016

Introduction

Patients presenting a carotid stenosis and contralateral carotid occlusion (CCO) have been historically considered at high risk of carotid endarterectomy (CEA) or carotid artery stenting (CAS).[1] In recent years, some high-risk patients were considered as acceptable candidates to receive CAS if performed by an experienced operator after a thoughtful selection.[2] However, until now, there are no large randomized controlled trial results, even a single center of short-term recovery clinical results of patients with CCO who received CAS treatment. The aim of the present study is to evaluate the short-term recovery effect and safety of stent implantation for patients with contralateral internal carotid artery occlusion, while at the same time, observing the clinical therapeutic results in aged, poor collateral, ischemic symptom, or cerebral infarction history subgroups of patients with CCO.

Materials and Methods

Study Population

The study comprised a retrospective review of a prospectively maintained database of Vascular Surgery and Neurosurgery Department at the Xuanwu Hospital of Capital Medical University from January 2008 through May 2014. Fifty-eight consecutive patients with CCO who had undergone stenting were identified. Approval for the study was obtained from the Xuanwu Hospital review board. CCO was defined as 100% occluded contralateral internal carotid artery. Inclusion criteria included carotid stenosis greater than or equal to 70% in asymptomatic patients or greater than or equal to 50% in symptomatic patients.[3] Exclusion criteria included acute stroke before CAS, spontaneous dissection, and inflammatory lesions.

Demographic and Clinical Data

The preoperative demographic data and lesion characteristics were collected and reviewed. The preoperative demographic data included age, gender, stroke history, and ischemic symptom. Patients were stratified by age (≥75 or <75 years), by the presence or absence of neurological ischemic symptoms, by the presence or absence of cerebral infarction history confirmed by clinic images evidence, and by primary or secondary collaterals. Primary collaterals were defined as collateral flow through anterior communicating arteries, posterior communicating arteries, or both. Secondary collaterals were defined as reversed blood flow through the ophthalmic artery, leptomeningeal collaterals, or both.[4]

Endovascular Procedures

All procedures were performed by 4 surgeons who were trained by one attending physician with the same procedural protocol in the endovascular suite using a fixed image intensifier (AX Axiom Artis dTA, 55094; Siemens, Forchheim, Germany). Hydrophilic-coated guidewire passed the stenosis lesion segment followed by distal embolism protection device (EPD) implantation. With regard to the choice of EPDs, considering the high stroke risk of balloon protective devices for patients with CCO, the filter device was selected routinely (FilterWire, Alajuela, Costa Rica, Boston Scientific or Spider, ev3, Plymouth, MN, United States). The selection of balloon size was in accord with the diameter of normal vessel just distal to the lesions. Inflation time was always 1-2 seconds until balloon filling was completely confirmed by fluoroscopy. Stent implantation undertaken with postdilation was applied to correct severe residual stenosis (>70%). The procedure was regarded as successful when residual stenosis is less than 30%. To reduce carotid dilation–related risk (bradycardia or hypotension), vasoactive drugs and atropine were on standby should they be required.

Procedure-Related and Endpoint Data Collection

After analyzing the results of perioperative (30-day) and follow-up, primary endpoint included nonfatal major stroke, nonfatal myocardial infarction (MI), and death. Major stroke was defined as a neurological deficit lasting more than 24 hours and scored as National Institutes of Health Stroke Scale (NIHSS) greater than or equal to 4.[5] MI was defined as chest pain or untypical discomfort, and was confirmed by electrocardiography and serum myocardial enzyme examination.[6,7] All patients were routinely examined with magnetic resonance imaging of the brain (included diffusion weighted imaging (DWI) sequence) and electrocardiography to determine the primary endpoints during follow-up.

All patients underwent regular checkups by carotid duplex ultrasonography and clinical examination in accordance with the following schedule: before discharge, 3rd month, 6th month, and 12th month, and subsequently, annually after the procedure. The final follow-up was June 1, 2017, when the postoperative follow-up time for all patients was longer than 3 years.

Statistical Analysis

Statistical analysis was performed by an independent statistician using SPSS statistic software package version 15.0 (SPSS Inc., Chicago, IL) and GraphPad Prism version 7.0 (GraphPad Software Inc., La Jolla, CA). Comparison of the clinical results between the 2 groups was calculated using chi-square test. Comparison of continuous variables was performed using a t test for independent samples. The time-to-event endpoint analysis was performed using the Kaplan–Meier method. P values $< .05$ were considered statistically significant.