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A study of carotid endarterectomy in a Chinese population: Initial experience at a single center

Yanfei Chen, Gang Song, Liqun Jiao*, Yabing Wang, Yan Ma, Feng Ling

Department of Neurosurgery, Xuan Wu Hospital, Capital Medical University, Beijing 10053, China

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ABSTRACT

Objective: This retrospective study aimed to evaluate our initial experience with carotid endarterectomy in a Chinese population.
Methods: Four hundred and thirty-three patients who underwent carotid endarterectomies at Xuan Wu Hospital Capital Medical University between January 1, 2001, and December 31, 2012, were reviewed. The postoperative 30-day complications were analyzed. Univariate and multivariate logistic regression analyses were used to analyze the factors associated with perioperative stroke and death.
Results: The overall 30-day complication rates after surgery were 4.08% for death and stroke, 3.63% for cranial nerve injuries, and 3.63% for heart complications. The mean follow-up time was 32.99 months, and only 11 cases required restenosis, including two that were symptomatic (experiencing transient ischemic attacks). In the univariate analysis, a history of cerebral infarction was present preoperatively in 179 patients, of whom 12 (6.70%) had a postoperative stroke or died ($P = 0.021$). Thirty-two patients had a modified Ranking score (mRS) ≥ 3, and six (18.75%) of these patients had a postoperative stroke or died ($P < 0.001$). In the multivariate logistic regression, female gender (OR: 4.669; 95% CI: 1.238–17.602; $P = 0.023$), current smoking habits (OR: 3.826; 95% CI: 1.298–11.277; $P = 0.015$), and an mRS ≥ 3 (OR: 1.540; 95% CI: 3.844–40.909; $P < 0.001$) were independent risk factors for perioperative stroke and death.
Conclusions: In our single-center study, carotid endarterectomies appeared to effectively prevent and treat the carotid artery stenosis that leads to stroke. Female gender, current smoking habits, and neurological deficits (mRS ≥ 3) increased the perioperative stroke and death rates.

1. Introduction

CEA has been the recommended optimal therapy for carotid stenosis. Many studies, such as The North American Symptomatic Carotid Endarterectomy Trial (NASCET), the European Carotid Surgery Trial (ECST), and the Asymptomatic Carotid Atherosclerosis Study (ACAS), have shown the efficacy and safety of carotid endarterectomy (CEA) in preventing cerebral strokes [1–3].

The NASCET assessed patients with stenosis >70% and the ECST assessed patients with stenosis of 70–99%, with both trials demonstrating that CEA is more effective than medication therapy. A meta-analysis showed that for patients with stenosis of 50–69%, CEA has some efficacy, whereas in patients with stenosis >70%, CEA is highly effective.

These studies demonstrated that in cases in which the indications for surgery are well assessed, CEA is safe and effective in reducing the morbidity of strokes.

However, as carotid artery stenting has provided another treatment method [5], the controversy over CEA and CAS still continues. Initially, CAS was considered preferable over CEA in high-risk patients; however, it has been shown recently that CEA is also suitable in the elderly, for whom age itself is also a high-risk factor [6].

In China, the morbidity of strokes has been 1.88% but has increased recently to 8.1%; therefore, the prevention of strokes is a serious issue that must be addressed. Since 2009, more efforts have been directed toward the screening and prevention of stroke in China, and more high-risk stroke patients have been treated [7]. However, the efficacy and safety of CEAs have not been thoroughly investigated because of a previous lack of attention to stroke prevention and physician training, and the outcomes following CEAs in the Chinese population are not clear. Therefore, we analyzed our initial experiences with CEA in a Chinese population based on the data on CEAs collected from the neurosurgery department of Xuan Wu Hospital Capital Medical.

* Corresponding author at: Department of Neurosurgery, Xuan Wu Hospital, Capital University of Medical Science, No. 45 Changchun Street, Xuanwu District, Beijing 100053, China. Tel.: +86 010 83198836; fax: +86 010 83198836.
E-mail address: jiaoliqun@gmail.com (L. Jiao).

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2. Patients and methods

2.1. Database

Detailed clinical information was obtained from the neurosurgery department of Xuan Wu Hospital Capital Medical University for the years 2001–2012. This retrospective study was a single-center study with 441 consecutive cases of CEA in 433 patients. The variables that were analyzed included the patients' demographic characteristics (e.g., age and sex), comorbidities, neurological status before CEA, degree of carotid stenosis, intraoperative parameters, and postoperative complications within 30 days of surgery, including death, stroke, cranial nerve injury, and heart complications. The patients who experienced contralateral limb symptoms, amaurosis, aphasia, neglect or dizziness were defined as symptomatic.

Before the CEA was undertaken, confirmation that there had been no new infarctions within 3 weeks was obtained in all patients using magnetic resonance imaging (MRI). CEAs were performed in all of the cases on the basis of the identification of carotid artery stenosis by duplex ultrasound and digital subtraction angiography (DSA) (NASCET standard [8]). Aspirin (100 mg) or clopidogrel (75 mg) was routinely administered both preoperatively and long-term postoperatively. All of the procedures were performed under general anesthesia using microsurgery. The intraoperative shunts were selected on the basis of a 50% reduction in the blood flow in the middle cerebral artery (MCA) as ascertained by the transcranial Doppler ultrasound (TCD) used for monitoring during the operation. The primary end points included perioperative stroke and death. Stroke was defined as in the NASCET as the persistence of a clinical neurological deficit beyond 24 h [8].

2.2. Surgery details

All of the surgery was performed under general anesthesia, with transcranial Doppler (TCD) used throughout to monitor the procedure; the leading edge of the sternocleidomastoid muscle was cut, exposing the carotid sheath and freeing and exposing the common carotid artery, the internal carotid artery and the external carotid artery. A noninvasive vascular clamp was used to block the adrenal, common carotid, internal carotid and external carotid arteries.

According to the TCD monitoring, when the cerebral artery blood flow decreased by more than 50%, intraoperative shunts were used. A longitudinal cut was made in the common and internal carotid arterial walls. The plaque tissue was cleared until the blood vessel wall became smooth, the distal vascular intima was neatly trimmed, and the vascular intima was raised up and sutured.

The vascular wall was continuously sutured under a microscope. Then, the occlusion clamps used on the external carotid artery, common carotid artery and internal carotid artery were opened in sequence. After opening the clamps, if the TCD monitoring showed an increase in the arterial blood flow of more than 150%, the common carotid artery was partially blocked and then opened gradually to prevent excessive infusion. After using ultrasonography to ensure the vascular patency, the incisions were sutured in turn.

2.3. Follow-up

The patients were followed-up 30 days after the surgery in the outpatient clinic and by telephone. In addition, duplex ultrasonography was performed at 3 months, 6 months, 1 year, and 2 years after the operation. Magnetic resonance imaging of the head was performed if cerebrovascular events were suspected. Restenosis was defined based on the results of a carotid ultrasound and was classified as moderate (50–69%), severe (70–99%), or occlusive (100%). Postoperative neurological morbidity was classified as transient ischemic attacks (TIAs) and stroke.

Table 1
Patient characteristics.

Characteristics	Cases (%)
Sex	
Male	391 (88.7%)
Female	50 (11.3%)
Age	62.92 ± 8.496 yrs
Medical history and comorbidities	
History of TIA	270 (61.2%)
History of cerebral infarction	179 (40.6%)
Hypertension	288 (65.3%)
Diabetes mellitus	126 (28.6%)
Hyperlipidemia	165 (37.4%)
Coronary heart disease	106 (23.1%)
Current smoking	141 (32.0%)
Family history of cerebrovascular disease	41 (9.3%)
PVD	33 (7.5%)
Previous cerebrovascular angioplasty or surgery	39 (8.8%)
Symptom type	
Asymptomatic	18 (4.1%)
Symptomatic	423 (95.9%)
mRS	
<3	409 (92.7%)
≥3	32 (7.3%)
Ipsilateral stenosis	
50–69%	3 (0.7%)
70–99%	373 (84.6%)
>99% occlusion	65 (14.7%)
Operated artery	
Left	238 (54.0%)
Right	203 (46.0%)
Shunting	81 (18.4%)
Antiplatelet therapy	
Aspirin	205 (46.5%)
Clopidogrel	236 (53.5%)

2.4. Statistical analysis

SPSS statistical software version 18.0 was used for the data analysis. The means ± the standard deviations were calculated for the continuous variables. Pearson's χ^2-test or Fisher's exact test were used for the comparisons between the categorical variables. The associations between the potential surgical risk factors and the 30-day perioperative outcomes were assessed first by univariate methods and then by multivariate logistic regression methods. The results of the univariate tests were compared either with the results of the Pearson χ^2-test or Fisher's exact test. All of the tests were two-tailed, and the level of significance was set at $P < 0.05$. Multivariate logistic regression was performed to assess the risk factors for postoperative stroke and death for all of the patients. The preoperative variables were entered into the multivariate regression analysis, and then stepwise selection was used in the regression analysis to determine which variables would remain in the final model. The odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the 30-day postoperative stroke and death.

3. Results

We studied a total of 433 patients undergoing 441 CEAs. All of the patients were of Han ethnicity, which comprises approximately 96% of the Chinese population. The descriptive characteristics and the symptoms before surgery for the included patients are shown in Table 1.

A total of 98.9% of the operations were successful, with failure experienced for five arteries that had >99% occlusion. The median time (MT) of the follow-up was 32.99 months. Only 11 cases (2.52%) of moderate restenosis or occlusion were observed following the