Clinical Research

Routine Shunting Is a Safe and Reliable Method of Cerebral Protection during Carotid Endarterectomy

Raffaello Bellosta, MD, Luca Luzzani, MD, Claudio Carugati, MD, Matteo Talarico, MD, and Antonio Sarcina, MD, Brescia, Italy

The purpose of this report is to describe the perioperative and long-term outcomes of standard carotid endarterectomy (CEA) with general anesthesia, routine shunting, and patching and to show that routine shunting is a safe and reliable method of cerebral protection. Between January 1998 and December 2004, 700 patients attending our Department of Vascular Surgery underwent 786 CEAs performed using a standardized technique. Forty-four patients were excluded from the analysis because they underwent combined CEA and coronary artery bypass grafting, so the analysis is based on the results of 742 CEAs in 656 patients (86 bilateral CEAs). The strict surgical protocol included general anesthesia and standard carotid bifurcation endarterectomy with routine shunting (Javid's shunt) and Dacron patching. The Javid shunts were easily inserted in 738 cases (99.4%) but could not be used in four cases (0.5%) because of the presence of a very small internal carotid artery. The mean ischemic time required to insert the shunt and complete the suture was 4.7 min (±1.15), and the mean time to perform the endarterectomy was 34.3 min (±6.7). The mean follow-up was 24.4 months (±17.3). Overall 30-day mortality was 0.1% (one patient) due to a contralateral major stroke. The 1-month perioperative neurological complication rate was 0.7%, with three major and two minor strokes. The cumulative stroke and death rate was 0.8%. Preoperative symptoms such as hypertension, contralateral occlusion, or an age of more than 80 years were not independent risk factors for perioperative stroke. In the long-term follow-up, Kaplan-Meier analysis indicated an estimated 5-year stroke-free rate of 98.0%. There were eight cases (1%) of >70% restenosis (four cases) or thrombosis (four cases) of the operated internal carotid artery during the follow-up in asymptomatic patients: in four cases, carotid stenting due to >70% restenosis led to good results. The Kaplan-Meier estimate of the restenosis-free rate was 97.8%. The combined stroke and mortality rate of 0.8%, and the restenosis rate of 1% support the argument that standard CEA performed with routine shunting as brain protection leads to excellent early and long-term results.

INTRODUCTION

The aims of carotid surgery are to relieve transient neurological symptoms, prevent strokes (thus improving the patients' quality of life), and, possibly, lengthen survival. Carotid endarterectomy (CEA) is better than medical therapy in treating asymptomatic stenoses of >70% and ipsilateral symptomatic stenoses of ≥50% and preventing major strokes,[1,2] but every carotid surgery team needs to evaluate its rates of operative mortality, postoperative neurological complications, long-term strokes, long-term stroke deaths, and long-term survival.

Carotid surgery raises a number of problems: patient selection, the most appropriate surgical technique (standard versus eversion CEA, direct suture versus patching of the arteriotomy), the use of general or locoregional anesthesia, intraprocedural cerebral protection, and whether or

Vascular Surgery Division, Poliambulanza Hospital, Brescia, Italy .

Correspondence to: Raffaello Bellosta, MD, Vascular Surgery Division, Poliambulanza Hospital, Via Bissolati 57, 25124, Brescia, Italy, E-mail: bellosta-raffaello@poliambulanza.it

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not to use a shunt and, if so, the kind of shunt to use.

The two main areas for which efficacy data are most lacking are shunting and anesthesia. There is some limited evidence that regional anesthesia may lower the risk of nonneurological perioperative complications compared to general anesthesia, but there was no evidence of a reduction in operative stroke risk.[3] Moreover, there is still insufficient evidence from randomized controlled trials to support or refute the use of routine or selective shunting during CEA.[4,5]

The aim of this report is to describe the perioperative and long-term outcomes of standard CEA performed under general anesthesia with routine shunting and patching to show that routine shunting is a safe and reliable method of cerebral protection.

PATIENTS AND METHODS

Between January 1998 and December 2004, 700 patients attending our Department of Vascular Surgery underwent 786 CEAs performed using a standardized technique; 44 patients were excluded from this analysis because they underwent combined CEA and coronary artery bypass grafting.

The indication for surgery was a >75% carotid stenosis as revealed by a duplex scan evaluated by a vascular specialist in all cases. The velocity criteria used to identify a >75% carotid stenosis were a peak systolic velocity (PSV) of >200 cm/sec, a ratio between the internal carotid artery (ICA) and common carotid artery (CCA) PSV of >4, or an end-diastolic velocity of >100 cm/sec. Angiography was used in 9% of the cases, only when there was suspicion of stenotic lesions involving the origin of the supra-aortic trunks or the intracranial ICA. All patients underwent preoperative brain imaging by means of computed tomography (CT, 87%) or magnetic resonance imaging (MRI, 13%) to show the cerebral status (i.e., ischemic lesions, cortical atrophia) and to detect possible other diseases (e.g., neoplasm); patients received platelet antiaggregation therapy (aspirin or ticlopidine) before and after surgery. The patients' characteristics are shown in Table I.

Duplex scans were made 1, 3, and 6 months after the operation and once a year thereafter. Carotid restenosis was defined as a reduction in carotid diameter of ≥50%; reintervention was indicated in the case of a restenosis of ≥70%. The velocity Duplex criteria used to identify a >50% carotid stenosis were a PSV of >150 cm/sec and an ICA:CCA PSV ratio of >3.

Table I. Characteristics of the patients undergoing CEA

Characteristics	Total (742 CEAs in 656 patients)
Mean age (years)	70.5 ± 7.3
Male/female	519/223 (70%/30%)
Hypertension	371 (50%)
Diabetes	118 (16%)
History of smoking	304 (41%)
Coronary heart disease	400 (54%)
Dyslipidemia	252 (34%)
Symptomatic	482 (65%)
Prior stroke	79
TIA	242
Amaurosis fugax	86
Drop attack	75
>80% Contralateral stenosis	50 (6.7%)
Contralateral carotid occlusion	36 (4.8%)

The classification, data analysis, and reporting procedures of the study respected the criteria established by the Society for Vascular Surgery/American Association for Vascular Surgery. Perioperative morbidity was divided into neurological and nonneurological complications occurring within 30 days of surgery. The former were classified as a temporary (<24 hr) lateralizing neurological or ocular event (transient ischemic attack, TIA) or a nondisabling (minor), disabling (major), or fatal stroke. The nonneurological complications were divided into cardiopulmonary complications (postoperative congestive heart failure, myocardial infarction, or respiratory complications requiring intensive care unit admission for >24 hr), wound complications (hemorrhages or hematomas requiring reintervention), or permanent cranial nerve injuries.

Operative Management

All of the operations were performed following a strict protocol involving general anesthesia, routine shunting (Javid shunt; Bard Impra, Tempe, AZ), and a carotid Dacron® patch (Hemashield finesse; Boston Scientific, Wayne, NJ).

The carotid bifurcation was approached by means of a laterocervical incision, with intravenous heparin (5,000 units) being administered before clamping. The CCA was temporarily clamped, and the ICA was closed using a vessel loop tourniquet; a longitudinal arteriotomy was made from the CCA to the ICA as far as necessary in order to ensure direct visualization of the end of the plaque. The shunt (closed with a Kelly clamp) was inserted into