THE RISK OF CEREBROVASCULAR ACCIDENT IN PATIENTS WITH ASYMPTOMATIC CRITICAL CAROTID ARTERY STENOSIS WHO UNDERGO OPEN-HEART SURGERY

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OBJECTIVE: To investigate whether the presence of asymptomatic critical carotid stenosis (ASCCS) increases the risk of perioperative stroke during open-heart surgery, which carries a well-established risk of cerebrovascular accidents.

DESIGN: A case series.

SETTING: A university-affiliated hospital that is a major referral centre for cardiovascular surgery.


INTERVENTIONS: Various cardiac procedures were performed on the 46 patients: 33 underwent coronary bypass grafting, 12 had valve replacement and 1 had heart transplantation.

MAIN OUTCOME MEASURE: Neurologic deficit.

RESULTS: None of the patients had any perioperative neurologic deficit up to the date of discharge.

CONCLUSIONS: Cardiac procedures, without prior carotid artery surgery, can be done in patients with ASCCS with no significant added risk of stroke. To achieve this, blood pressure should be kept stable intraoperatively, at slightly higher than normal pressure.

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open-heart surgery carries a well-established risk of cerebrovascular accident. However, it is controversial whether patients with asymptomatic critical carotid stenosis (ASCCS) are at even higher risk than others, and whether surgical treatment of ASCCS should be carried out first, as has been advocated by a number of authors.1–8 Others, however, feel that there is no added risk and have advocated ignoring asymptomatic carotid stenosis.9–11 Our centre has adopted the latter approach, however, it is controversial whether patients with ASCCS and who underwent open-heart surgery without carotid endarterectomy between January 1992 and January 1996. By comparing our results with those of other studies documented in the literature, we hoped to determine whether ASCCS increases the risk of perioperative cerebrovascular accidents in patients who undergo open-heart surgery.

**Patients and Methods**

The study population comprised 46 patients (18 women, 28 men) with ASCCS who had various open-heart procedures alone, without carotid artery surgery, between 1992 and 1996. After thorough history-taking and physical examination, those patients admitted to our institution for elective open-heart procedures who demonstrated carotid bruits (unilateral or bilateral) were referred for Doppler scanning to evaluate the extent of their carotid artery disease. Those who had critical stenosis of more than 60% and were totally asymptomatic (i.e., no history of transient ischemic attacks [TIA]) were included in the study. The age distribution is shown in Table I. Twenty-seven patients had bilateral and 19 had unilateral critical carotid artery stenosis greater than 60% (Table II). Coronary artery bypass grafting (CABG) was performed on 33 patients, valve replacement on 12 patients and heart transplantation on 1 patient (Table III). Of the entire group, 33 patients had a history of hypertension and 6 patients suffered from chronic atrial fibrillation. Cardiopulmonary bypass (pump) time ranged from 24 to 197 minutes (mean 98 minutes). Preoperatively, 34 patients were treated with acetylsalicylic acid and 5 were treated with coumadin; the remaining 7 were not taking any form of anticoagulation or antiplatelet therapy.

Direct carotid Doppler spectral analysis was performed by the same experienced registered vascular technologist using a 5-mH continuous wave probe. Carotid Doppler signals were analysed with a real-time sound spectral analyser. Techniques and diagnostic criteria described by Barnes and Rittgers12,13 were used. Also, the techniques and criteria discussed by Moore and Bean14 were used for indirect testing by periorbital Doppler, utilizing a 10 mH bidirectional probe. The Doppler scanning techniques used by our institution for over a decade have been found to provide a simple, rapid and accurate method of assessing hemodynamically significant stenosis. In our study, 60% stenosis (i.e., a greater than 60% reduction in the diameter of the internal carotid artery) was considered a critically significant lesion (this is the definition that was used by the Asymptomatic Carotid Atherosclerosis Study of 199415). The carotid Doppler ultrasonography was done by the same technician, and its accuracy in detecting hemodynamically significant lesions was tested blindly and adequately by comparing the results with angiography and duplex ultrasonography.

For the 46 patients in the study,
stringent guidelines of care were followed in the operating room. Precautions were taken by both the anesthesiologist and perfusionist to maintain stable blood pressure throughout the procedure and, specifically, to keep the mean blood pressure between 60 and 70 mm Hg while each patient was on cardiopulmonary bypass. Postoperatively, the systolic blood pressure was kept slightly higher than usual. For example, a systolic pressure of 140 mm Hg is acceptable, especially in patients who have preoperative hypertension.

In addition, the anesthesiologist took every precaution to avoid potential trauma to the carotid arteries by inserting pulmonary artery catheters and the invasive monitoring devices on the unaffected side of those patients with unilateral lesions, and by opting for a subclavian rather than jugular approach to invasive monitoring in those with bilateral lesions. Each patient’s neurologic status was evaluated preoperatively and immediately postoperatively, with regular neurologic examinations performed at least daily while the patient remained in hospital. This was done by the nursing staff and the surgeons caring for the patients. Because the study was designed to evaluate specifically the effect of the actual surgical procedure on the stroke rate, the incidence of neurologic deficits was reported only for the immediate postoperative period (up to the discharge date) rather than for the standard 30 days.

**RESULTS**

No patients suffered any neurologic deficits perioperatively for a period ranging from 6 to 15 days (mean 6.9 days). In addition, there were no reported deaths or significant morbidity in any of the patients enrolled in the study. Delayed discharge periods of more than 7 days were due to the need to adequately control the resistant postoperative atrial fibrillation in 7 patients and to monitor the coumadin dosage in 5 patients.

**DISCUSSION**

There is general agreement in the literature that symptomatic critical carotid stenosis is associated with a 5-year stroke rate of 20% to 30%.\(^1\) Other investigators contend that even asymptomatic lesions and stenosis of a lower degree (as low as 50%) increase the overall rate of TIA and the stroke rate.\(^6\) We adopted the definition of critical stenosis used in the Asymptomatic Carotid Atherosclerosis Study (ACAS) of 1994, where it was defined as a 60% or more reduction in the diameter of the internal carotid artery.\(^1\)

There is little controversy regarding the treatment of symptomatic critical carotid stenosis. Numerous studies have indicated an increased incidence of strokes if such a lesion is not surgically corrected.\(^1\) Like others, Hertz and colleagues\(^1\) concluded that such severe disease warrants surgical treatment (i.e., carotid endarterectomy in conjunction with CABG to achieve additional protection from perioperative strokes).

However, the management of patients with coexisting ASCCS and coronary artery disease continues to be controversial.\(^1\) Some researchers believe that the presence of ASCCS in conjunction with coronary artery disease increases the incidence of cerebral vascular accidents.\(^1,6,7,20,21\) The impact of coexisting carotid artery disease on the stroke rate after CABG has recently been documented in 2 large, prospective, follow-up studies.\(^12\) The incidence of stroke in patients with carotid bruits, a history of previous stroke, TIA, or documented severe carotid artery disease while undergoing CABG has been estimated in case-controlled studies\(^7,8\) and comparative studies\(^8,14\) to be approximately 6%. Other prospective studies have evaluated the risk of
stroke in patients who have undergone CABG in the presence of extracranial bruits or documented evidence of extracranial lesions. Overall, the stroke rate in this population was approximately 3% to 4% in patients with asymptomatic stenosis and about 20% to 30% in those with symptomatic lesions.\textsuperscript{1-2,6,13,15}

In addition, patients with documented carotid artery stenosis that was not surgically corrected showed a 4% stroke rate per year during the first 4 years after isolated CABG.\textsuperscript{3} A recent follow-up study by Brener and colleagues\textsuperscript{7} showed that the presence of carotid artery stenosis of 50% or greater in patients who undergo CABG increased the overall rate of TIA's and strokes from 1.9% to 9.2%. In light of the above-noted findings, many researchers have suggested that ASCCS be treated when it coexists with coronary artery disease. In 1994, the ACAS\textsuperscript{10} concluded that asymptomatic patients with hemodynamically significant carotid artery stenosis (a 60% reduction in diameter of the internal carotid artery) had fewer strokes when treated with a combination of carotid endarterectomy (CEA) and optimum medical management (i.e., 325 mg acetylsalicylic acid and risk factor reduction) than those treated with optimum medical management alone. In patients scheduled for CABG known to have bilateral hemodynamically significant lesions, many authors advocate treatment of at least 1 carotid artery as a staged procedure before coronary revascularization.\textsuperscript{7-10,13,15} Vermeulen and colleagues\textsuperscript{9} have suggested that in patients with severe carotid disease, simultaneous CEA and CABG should be considered if both hemispheres are prone to stroke.

On the other hand, some authors have advocated a more conservative, nonoperative approach to asymptomatic carotid artery stenosis.\textsuperscript{9,13,15} This approach is based on the fact that although asymptomatic carotid stenosis may be identified in approximately 10% of all candidates for myocardial revascularization, the perioperative stroke rate in this particular group has been reported not to exceed the usual figure (less than 3%) expected for CABG procedures.\textsuperscript{5,10,12,13,14} Furthermore, published reports suggesting an increased perioperative stroke rate, as mentioned previously, may be fraught with confounding variables. Gardner and associates\textsuperscript{1} have demonstrated the additional influence of factors such as increasing age and cardiopulmonary bypass time. Similarly, others have found that early death and stroke rates associated with CABG are directly related to age.\textsuperscript{11-15} Vermeulen and colleagues\textsuperscript{1} revealed, in their analysis of risk factors for all operative neurologic complications, that the preoperative occurrence of severe neurologic accidents, with or without residual deficits, and preoperative severe left ventricular dysfunction were significantly associated with postoperative neurologic events. Loop and associates\textsuperscript{2} reported that postoperative strokes occurred after CABG in 137 (2.7%) of 5070 patients 65 years of age or older, and Gardner and associates\textsuperscript{2} indicated that the risk of early stroke escalated to 6.3% among those over 70 years of age. Advanced age may contribute to higher stroke rates postoperatively because of the higher risks of atheromatous embolization during manipulation of the ascending thoracic aorta and less tolerance for cardiopulmonary bypass because of intracranial arterial disease.

The wide variations in the composition of the published series of patients with coexisting severe carotid and coronary artery disease make it difficult to reach concordant conclusions. For example, factors such as the percentage of patients with previous strokes or TIA's and the number of patients with severe bilateral or unilateral disease vary from one study to another.\textsuperscript{2} In addition, from a practical standpoint, the relatively low prevalence of serious carotid artery disease in patients scheduled for CABG precludes the evaluation of large study populations.\textsuperscript{15} Many factors contribute to the difficulty in drawing conclusions about patients coexisting severe carotid and coronary artery disease. In our study, the 46 patients with preoperative documented evidence of ASCCS were taken from a pool of 4107 patients who underwent various cardiac procedures between 1992 and 1996. The general incidence of postoperative stroke in this pool of patients was 1.7%. The selected 46 patients underwent various open-heart operations involving careful intraoperative precautions and experienced no evidence of any perioperative neurologic deficits before discharge from hospital. Such significant results could stem from the operative precautions that were taken (i.e., maintaining a stable blood pressure and avoiding compression of the carotid arteries). Although the number of patients in this study is relatively small and a larger series may be required to establish more concrete conclusions, the age distribution, degree of stenosis, length of pump time and the type of surgical procedure represent most of the important variables in this controversial surgical problem. Overall, this study showed that cardiac surgery alone, without carotid endarterectomy, can be done in patients with ASCCS with no added risk of perioperative neurologic complications. In addition, we noted that preoperative anticoagulation or antiplatelet therapy, cardiopulmonary pump time and type of heart procedure were not significant variables.
References


