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Cervical Carotid Revascularization: Indications from a Surgical Perspective

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Atherosclerotic narrowing and ulceration at the carotid bifurcation is a major cause of thromboembolic stroke. The results of several prospective randomized trials for symptomatic and asymptomatic carotid occlusive disease have provided evidence-based data for treatment of the same. By 1990, seven trials were planned or in progress. Four of these trials addressed asymptomatic carotid occlusive disease (Carotid Artery Stenosis Asymptomatic Narrowing Operation Versus Aspirin study, Mayo Asymptomatic Carotid Endarterectomy study, Veterans Administration Asymptomatic Stenosis Trial [VAAST], and the Asymptomatic Carotid Atherosclerosis Study [ACAS]) [1–4]. Patients could not have symptoms from ipsilateral cerebral ischemia secondary to carotid occlusive disease, although contralateral symptoms were permitted in the VAAST and ACAS. The four trials used similar exclusion criteria. Patients with neurologic (eg, seizures, dementia), cardiac (eg, atrial fibrillation, severe valvular disease), or general medical conditions (eg, diabetes, renal failure) that might affect stroke outcome were also excluded [5]. There is one ongoing asymptomatic carotid surgery randomized trial in the United Kingdom and Europe, the Asymptomatic Carotid Surgery Trial [6]. No results are available from this trial at the present time.

The ACAS randomized 1662 patients with greater than 60% stenosis (by angiography or Doppler ultrasound) to surgery versus best medical management. All patients received daily aspirin (325 mg). Nonwhite populations comprised only 5% of the study group. The projected risk of ipsilateral stroke at 5 years (mean follow-up of 2.7 years) was 5.1% for the surgical group and 11% for medical management. This represented an overall relative risk reduction of 53%. This risk reduction was more apparent for men and independent of degree of stenosis or contralateral disease. The calculated stroke risk for the medical management arm was 2.2% per year. The perioperative risk of stroke and death was 2.3% plus an additional risk of 1.2% for arteriography. Surgical benefit was noted at 10 months after randomization and remained statistically significant at 3 years [4].

Three trials focused on symptomatic carotid occlusive disease (North American Symptomatic Carotid Endarterectomy Trial [NASCET], Veterans Administration Symptomatic Stenosis Trial [VASST], and European Carotid Surgery Trial [ECST]) [7–10]. All three of these trials were terminated early. The NASCET and VASST maintained that participating centers must have surgical morbidity rates of less than 6%. Inclusion criteria were relatively similar among the trials and included transient retinal ischemia, transient cerebral ischemia, or minor completed stroke within 120 days of randomization in the distribution of the carotid artery lesion [11].

The NASCET was terminated early secondary to significant risk reduction in patients with greater than 70% stenosis in the surgical arm. Six hundred fifty-nine patients with symptomatic carotid stenosis between 70% and 99% were randomized to surgical (328 patients) and nonsurgical (331 patients) treatment arms. Ipsilateral stroke

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risk at 2-year follow-up was 9% for the surgical group versus 26% for the nonsurgical group. This represented a 71% relative risk reduction ($P < 0.001$). According to these findings, one stroke could be prevented for every 6 to 7 endarterectomies performed. A significant correlation was noted between severity of stenosis and surgical benefit. The protective effect of endarterectomy was durable over time and independent of age, gender, and stroke risk factors [7]. At 5-year follow-up for 2226 patients with 50% to 69% stenosis randomized to nonsurgical and surgical arms, the ipsilateral stroke rate was 22.2% versus 15.7% (nonsurgical versus surgical; $P = 0.045$). Author estimates were that 15 endarterectomies would have to be performed to prevent one stroke in a 5-year period. Those individuals with less than 50% stenosis did not benefit from endarterectomy. Contralateral occlusion was a strong risk factor for stroke, though contralateral stenosis was not [8]. Timing of surgery did not affect surgical risk.

The ECST stenosis criterion was 0% to 99%. The trial randomized 3018 patients, 1807 to surgery and 1211 to best medical management. The trial was terminated early at an interim analysis of 2200 patients. Follow-up was 5 years, with a mean of 2.7 years for those with less than 30% stenosis and 3.0 years for those with greater than 70% stenosis. Sample size was 374 for the less than 30% stenosis group and 395 for the greater than 70% stenosis group. The primary end point was ipsilateral stroke. The mild stenosis group (<30%) revealed no statistically significant difference between surgical and nonsurgical arms with respect to stroke incidence. The severe stenosis group (>70%) revealed a benefit to the endarterectomy arm, with a 10.3% total risk of stroke (ie, 7.5% risk of stroke or death within 30 days plus an additional 2.8% risk of stroke) versus a 16.8% risk in the nonsurgical arm. The total 3-year risk of disabling or fatal stroke was 6.0% versus 11.0% in the surgical versus nonsurgical arms, respectively. Surgical benefit outweighed best medical management risk in patients with 70% to 80% stenosis. This benefit was realized 2 to 3 years after randomization [10]. ECST data reanalysis using NASCET criteria revealed a significant surgical benefit for patients with 70% stenosis.

A critical analysis of these studies provides convincing evidence for the surgical treatment of carotid occlusive disease in asymptomatic patients with greater than 60% stenosis and symptomatic patients with greater than 50% stenosis [12,13]. Note, however, that surgical benefit for women in the ACAS was not apparent and that nonwhite patients comprised only 5% of the study population. Also, ACAS and VAAST surgeons and patients were specifically selected for low surgical risk (perioperative morbidity and mortality <3%). In the symptomatic carotid stenosis trials, benefit of endarterectomy was observed in the setting of low surgical risk. Surgical benefit in nonselected populations may be less predictable.

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