Carotid endarterectomy in symptomatic stenosis

Carotid endarterectomy is the most effective strategy to prevent ischaemic strokes in patients with haemodynamically significant symptomatic carotid artery stenosis. This article reviews the current status of carotid endarterectomy in symptomatic patients with carotid stenosis.

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People with symptomatic carotid stenosis of 50–99% according to North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria and 70–99% according to European Carotid Surgery Trial (ECST) criteria should be assessed and referred for consideration of carotid endarterectomy (CEA) within one week of onset of a non-disabling stroke or transient ischaemic attack (TIA) and undergo surgery within a maximum of two weeks of onset of symptoms (National Institute for Health and Clinical Excellence (NICE) 2008).1

Severe internal carotid artery (ICA) stenosis is an independent risk factor for carotid territory TIA and cerebral ischaemic stroke. Symptomatic severe ICA stenosis causing a TIA carries 12%–13% risk of stroke within the first year and causing a stroke carries a 5%–9% risk of a further stroke per year.2

CEA, whereby a atherosclerotic plaque is surgically removed from the intima of the internal carotid artery, is a safe and highly beneficial treatment for prevention of stroke and TIA in carefully chosen patients with symptomatic severe internal carotid artery stenosis.

History

In 1953, De Bakey performed the first successful CEA. In 1954 Eastman added the procedure of shunting. This increased the confidence of the surgeons in the procedure so that between 1974 and 1985, more than one million operations were performed all over the world. However, the number of CEAs decreased in the mid-1980s after unsuitable choice of patients led to an increased incidence of perioperative mortality and death.3

Since then, there has been resurgence in the surgical procedure following the publication of two successful randomised controlled trials, NASCET and ECST, showing the efficacy of CEA in symptomatic ICA stenosis.4,5

ECST, published in 1998, was a multicentre randomised controlled trial that included 3024 patients.5 Some 60% of the patients were randomised to optimal medical treatment and 40% to optimal medical treatment with CEA. The trial demonstrated that, in patients with more than 80% stenosis, the three-year risk of stroke and death was 26.5% in medically treated group and 14.9% in patients undergoing CEA.

NASCET, published in 1999, was a multicentre clinical study of 2226 patients randomised into two groups of optimal medical treatment and optimal medical treatment with CEA.4

Box: Prevalence of ICA stenosis

0.5% Over 60 years
10% Over 80 years

It is the cause of ischaemic stroke in 15–20% of cases
Stenosis was diagnosed by catheter angiography. CEA was demonstrated to be highly beneficial in stenosis of 70–99%.

It demonstrated that the two-year risk of stroke was reduced from 25% in the medically treated group to 9% in the surgically treated group, with absolute risk reduction of 17%. The number needed to treat (NNT) at two years was six. CEA was moderately effective in moderate stenosis but did not show any benefit in near occlusion. The overall rate of perioperative stroke and death was 6.5%.

In both studies, catheter angiography was used to calculate the degree of stenosis. NASCET divided the diameter at the site of maximum narrowing by the distal ICA diameter where the vessel walls become parallel beyond post-stenotic dilatation. ECST divided the diameter at the site of maximal narrowing by the estimated diameter of the normal bulb. Thus, the NASCET method produced a lower percentage narrowing of the lumen for a specific degree of stenosis compared with the ECST calculation (eg, 70% stenosis using NASCET equals 82% using ECST). The results of the two trials were similar when the NASCET method was applied to ECST angiograms.

Pathophysiology

The process of atherosclerosis over time leads to the formation of atherosclerotic plaque in the intima of the ICA, leading to the narrowing of its lumen. The atherosclerotic plaque has the propensity for rupture leading to thrombus formation, which causes further luminal narrowing and is also liable to break into the circulation causing subsequent embolic phenomenon.

Atherosclerosis has a predilection for carotid bifurcation and the first 2 cm of the internal carotid artery. On the basis of ICA narrowing, stenosis is considered:
- Mild if luminal narrowing is 0–29%
- Moderate if narrowing is 30–69% (ECST criteria)
- Severe if luminal narrowing is 70-99% (ECST criteria) or 50–95% (NASCET criteria)

Clinical features

Bruit is not a reliable sign of stenosis and may be absent especially in high-grade stenosis.

Amaurosis fugax (transient monocular blindness due to retinal ischaemia or infarction) indicates stenosis as do cerebral hemispheric stroke and carotid territory TIA.

Duplex ultrasound of ICA has a sensitivity of 86% and specificity of 87% in detecting severe stenosis.

Magnetic resonance angiogram has a sensitivity of 95% and specificity of 90% in detecting severe stenosis.

Although MR angiography offers many valuable advantages, CT angiography allows faster imaging that can be offered at any time of the day or night. Digital subtraction angiography carries 0.9% risk of stroke and 0.45% risk of TIA.

Indications for CEA

Severe stenosis of 70%–99% is a definite indication for CEA, while the procedure may also be indicated where stenosis is moderate (50%–69%).

Contraindications for CEA include:
- Complete carotid artery stenosis or occluded carotid artery
- Previous disabling stroke
- Patient unfit for anaesthesia
- Co-morbidities reducing the life expectancy to less than five years (eg, chronic cardiac failure, angina, uncontrolled hypertension and severe respiratory insufficiency).

Intraoperative monitoring

It is important to monitor the adequacy of cerebral circulation. The following methods are used:
- Transcranial Doppler of the intra-cranial arteries
- Continuous EEG
- Cerebral oximetry
- Stump pressure
- Continuous oxygen saturation, BP and ECG during the operation
- Intraoperative angiography
- Vascular endoscopy.

CEA in older patients

The Asymptomatic Carotid Artery Surgery Trial was the first study to include patients up to age of 79 years. It showed that CEA reduced the five-year stroke risk from 12% to 6% in symptomatic patients younger than 75 with ICA stenosis of 70% or more on Doppler ultrasound but those aged 75 or older did not benefit.

Despite other studies showing the efficacy of CEA in people of 80 years or more, there is still a hesitancy to perform this
Box 2: Complications

**Perioperative (NASCET)**

- Stroke/death 5.8%
- Myocardial infarction 0.9%

**Postoperative**

- Cranial nerve injury 8.6%
- Wound haematoma 5.5%
- Hypotension 5.0%
- Seizure 0.6%
- Intracerebral haemorrhage 0.2%

Also: hypertension and hyperperfusion syndrome (especially in patients with prolonged hypertension)

procedure in this age group due to perceived ideas of increased perioperative mortality and poor outcome. In NASCET, patients older than 75 years with symptomatic ICA stenosis appeared to benefit more from CEA than younger patients.4

In 2001, Alamowitch showed that patients older than 75 years enjoyed greatest benefit and had the lowest rate of perioperative complications. Those aged under 65 gained least benefit.14

Miller, in his review of patients undergoing CEA, emphasised that patients above 80 years should not be randomly considered as high risk.15 The US Census showed that life expectancy at 80 years is 8.3 years and at 85 years is 6.3 years.16 Thus old and young patients should have similar criteria for selection.15

In terms of patients with asymptomatic carotid artery disease, data from the Swedish national data bank suggest that endarterectomy is only effective in men up to the age of 73 and is ineffective in women over the age of 65.17

The option of carotid angioplasty or stenting should only be carried out in specialist centres where outcomes of these techniques are routinely audited and preferably as part of a randomised clinical trial.1

**Conclusion**

Carotid endarterectomy is a safe and highly beneficial treatment for the prevention of ischaemic stroke and TIA in patients with symptomatic ICA stenosis.

Age is not a contraindication for CEA; indeed the NASCET study showed that older patients benefited more from CEA than younger patients.5

Considering that life expectancy at 80 years and above is at least five years, older patients should have the same criteria for CEA as younger patients.

According to the NICE guidelines 2004 and 2008, any patient with carotid artery territory stroke but without severe disability or a TIA found to have carotid artery stenosis of 70–99% should be referred for CEA within one week of onset of stroke or TIA symptoms and undergo surgery within two weeks of onset symptoms.1

The National Stroke Strategy, however, recommends that carotid intervention for recently symptomatic severe carotid stenosis should be regarded as an emergency procedure in patients who are neurologically stable, and should ideally be performed within 48 hours of a TIA or minor stroke.18

**References**


