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EDITORIAL

Endovascular or Surgical Treatment for Carotid Artery Stenosis?☆

The management of carotid atherosclerosis remains one of the most controversial areas of vascular practice despite attracting more randomised trials than any other problem in peripheral artery disease. Presently the most hotly debated topic is carotid stenting. Over the last decade there has been an increasing shift towards the endovascular treatment of most vascular beds. In many countries this also applies to the treatment of carotid stenosis. In this issue of *The European Journal of Vascular and Endovascular Surgery* Luebke and colleagues present a meta-analysis of trials comparing endovascular and surgical treatment of carotid stenosis. The main findings are that endovascular therapy was associated with increased risk of perioperative stroke, OR 1.50 (95% 1.05–2.16), but a reduced risk of cranial nerve injury, OR 0.15 (95% CI 0.09–0.26).[1] No difference in outcome at one year was found, however, few of the studies have as yet reported at this time point. Based on these findings the authors concluded that endarterectomy remains the ''gold standard'' in the treatment of carotid stenosis and carotid stenting should only be carried out as part of an on-going randomised trial. It should be noted that the authors finding of a worse perioperative outcome in patients randomised to endovascular intervention only held for a fixed effect model and was not demonstrated with the statistically more conservative random effect model.[1]

An earlier meta-analysis by Coward and colleagues reached similar conclusions, although no difference in perioperative stroke rate was found.[2] This study preceded two of the trials included in the present analysis.[3,4] Of the seven trials examined in the meta-analysis of Luebke *et al.*, five contributed most of the patients (Table 1).[3–7] Examination of the perioperative outcomes from these studies demonstrates a number of important points. Firstly, the findings of the five trials are quite variable. One trial found a significant two-fold higher perioperative stroke and death rate in patients randomised to endovascular intervention.[4] Another smaller trial reported similar findings which were of borderline statistical significance.[6] The findings of the later study have only been reported in abstract form making examination of this trial problematic.[6] The other three main trials, including the largest study involving approximately 1200 patients, reported no difference in the main 30 day outcome between surgery and endovascular treatment (Table 1).[3,5,7] The 30 day stroke and death rate varied from 5.4 to 12.1% in patients receiving endovascular intervention and 3.8 to 9.9% in those treated by surgery (Table 1).

This variability in outcome is quite concerning. The stroke-mortality rate in six of the 10 intervention groups from these five trials is higher than in any of the intervention groups from the original trials, which demonstrated the value of carotid endarterectomy over medical treatment (Table 1).[8–11] This finding is even more concerning when it is appreciated that three of the four trials which compared endarterectomy to medical therapy were completed in the 1990s when the value of anti-platelet medication, statins, Angiotensin II inhibition and β-blockade were less clear.[8,10,11] Thus it is likely that the outcome for symptomatic carotid atherosclerosis treated by best medical therapy alone today would be considerable better than reported in NASCET and ECST.[10,11]

The stroke-mortality rates reported in the trials comparing endovascular and surgical treatment of carotid stenoses are well outside the thresholds acceptable for asymptomatic carotid intervention (Table 1). Although only one trial included a significant number of asymptomatic patients (71% in SAPPHIRE), it is hard to imagine that either intervention is adding much to the treatment of asymptomatic carotid stenosis based on these independent physician audited outcomes. As pointed out by Luebke and colleagues, endovascular therapy of carotid atherosclerosis is an evolving therapy. Placement of stents has now become standard, as has dual anti-platelet therapy. Cerebral protection devices are increasingly used for endovascular carotid stenting. The trial

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Table 1. Perioperative outcome of patients randomised in the five main trials of endarterectomy and stenting in the treatment of carotid atherosclerosis

Study	Asymptomatic	30 d stroke/death		Significance	MI		Cranial nerve injury		Stent	Protection device
		Endovascular	Surgery		Endovacular	Surgery	Endovacular	Surgery		
CAVATAS[5]	17/504 (3.4%)	25/251* (10%)	25/253* (9.9%)	0.98	0/251	3/253 (1.2%)	0/251	22/253 (8.7%)	55/251 (21.9%)‡	0/251
WALLSTENT[6]	0/219	13/107 (12.1%)	5/112 (4.5%)	0.049	NS	NS	NS	NS	107/107 (100%)	NS
SAPPHIRE[7]	238/334 (71.3%)	9/167† # (5.4%)	13/167† # (7.8%)	0.36	5/167¶ (3.0%)	12/167¶ (7.2%)	0/167	8/167 (4.8%)	159/167 (95.2%)‡	159/167 (95.2%)‡
SPACE[3]	0/1183	46/599† (7.7%)	38/584† (6.5%)	0.1	NS	NS	NS	NS	567/599 (94.7%)‡	151/599 (25.2%)‡
EVA-3S[4]	0/527	25/265 (9.4%)	10/262 (3.8%)	0.01	1/265 (0.4%)	2/262 (0.8%)	3/265 (1.1%)	20/262 (7.6%)	247/265 (93.2%)‡	227/262 (86.6%)‡
Total	255/2767 (9.2%)	118/1389** (8.5%)	91/1378** (6.6%)		6/683 (0.9%)	17/682 (2.5%)	3/683 (0.4%)	50/682 (7.3%)	1135/1389 (81.7%)	537/1279 (42.0%)

All data based on intention to treat. Stroke defined as focal neurological symptoms lasting more than *7 days or †1 day.
Included ipsilateral stroke up to 1 year after treatment; NS = not stated; ‡ rate based on intention to treat; ¶ included enzyme defined MI; ** Chi-squared for this comparison gives $p = 0.06$ or 0.07 (corrected).
N.B., 30d stroke/death rates ACAS 2.3%,[8] ASCT 3.1%,[9] ECST 7.5%,[10] NASCET 5.8%.[11]

with the highest rate of protection device use reported the lowest perioperative stroke rate.[7] EVA-3S however had only a marginally lower protection device use but almost double the stroke-mortality rate of the SAPPHIRE study.[4] The good outcome in the SAPPHIRE study may thus relate to the high percentage of asymptomatic stenoses treated in that trial (Table 1).

Our conclusions must take into account the evolving nature of endovascular therapy. The trials presently on-going may give a more realistic appraisal of the value of endovascular therapy in a setting where technology and protocols have become more established.[12] It can however be noted from the table that the perioperative endovascular outcomes were little improved in the recent EVA-3S trial compared to the first major trial in which no protective devices were available and stenting was frequently not performed.[4,5] It would thus appear appropriate to continue investigation of endovascular therapy for symptomatic carotid atherosclerosis as part of ongoing trials which are already established. It would presently appear inappropriate to treat asymptomatic carotid atherosclerosis by endovascular means in most instances. Indeed it remains uncertain that the excellent perioperative outcomes reported for endarterectomy in ACAS and ACST can be reproduced in general practice.[8,9]

Ultimately, the lesions for which endovascular therapy is most appropriate may reflect the strength of this technique and the weaknesses of endarterectomy. Few would argue with the use of carotid stenting for symptomatic restenosis, in the presence of past neck irradiation or when the stenosis is surgically inaccessible. Endarterectomy is clearly more appropriate however when the aortic arch is markedly unfolded and atheromatous making an endovascular pathway to the carotid artery hazardous.

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J. Golledge*
Vascular Biology Unit, School of Medicine, James Cook University, Townsville, Australia

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*Corresponding author. Professor J. Golledge, Director, The Vascular Biology Unit, Department of Surgery, School of Medicine, James Cook University, Townsville, Queensland 4811, Australia.
E-mail address: jonathan.golledge@jcu.edu.au