

## CORRESPONDENCE

## Ocular Defects as Surrogate End-Points in Trials Comparing Carotid Endarterectomy and Stenting

The effect of carotid endarterectomy (CEA) and carotid artery stenting (CAS) on visual function has not been a specific end-point of most trials comparing CAS and CEA. Ischaemic lesions of the retina and optic nerve have been reported to occur in 15–46% of carotid patients,<sup>1</sup> while carotid artery stenosis significantly reduces blood flow to the eye and orbit, resulting in the ocular ischaemic syndrome.<sup>2–5</sup>

Both CAS and CEA have been reported to prevent further episodes of amaurosis fugax, correct paresis of the pupil muscle, decrease neovascularization of the optic nerve head and iris, and improve blood flow to the orbital vessels.<sup>1–5</sup> However, emboli generated during CAS and CEA may also cause ischaemic lesions of the ophthalmic artery, leading to transient or permanent blindness.<sup>6,7</sup> Ophthalmic artery colour Doppler flow imaging, fluorescein angiography, and retinal photography have been used to detect new emboli generated during the carotid revascularization procedures.<sup>6</sup>

CAS is associated with a higher incidence of cerebral microemboli compared with CEA.<sup>8–10</sup> These microemboli are major risk factors for postprocedural cerebral deficits.<sup>8–10</sup>

Although most of these microembolic events are not associated with deterioration in cognitive performance and functions, or may only be associated with a transient dysfunction, their long-term effects are uncertain.<sup>11</sup> It has been suggested that subclinical infarcts on magnetic resonance imaging (MRI) are a risk factor for cognitive impairment.<sup>12</sup> Furthermore, such microemboli may contribute to cognitive decline, vascular dementia, and Alzheimer's disease,<sup>13,14</sup> and may be associated with a higher (greater than threefold) risk of future stroke.<sup>15</sup> Therefore, long-term follow-up with neurocognitive testing and repeated MRI imaging may be essential to provide better insight into the nature of these lesions.<sup>9,10</sup>

Although much attention has been given to the effects of CAS and CEA on brain circulation, the effects of CAS versus CEA on visual function are unknown. Improvement in blood flow following CEA/CAS can improve chronic ischaemia of the orbital vessels but, on the other hand, it may turn out that microemboli generated during CAS and/or CEA adversely affect visual function. Current or future trials comparing CAS and CEA may, therefore, provide a unique opportunity to investigate and report on this subject.

The Asymptomatic Carotid Surgery Trial-2 (ACST-2) is currently the largest trial to compare CAS with CEA in patients with severe asymptomatic carotid stenosis.<sup>16</sup> Thus, it may represent a unique opportunity to investigate the effects of both procedures on the eye circulation and the retina. Potential differences between the two procedures may be used as another surrogate end-point on which the merits of each procedure could be judged. Finally, these results could provide additional useful data on the effects of carotid revascularization procedures in asymptomatic patients.

## REFERENCES

- 1 Neroev VV, Kiseleva TN, Vlasov SK, Pak NV, Gavrilenko AV, Kuklin AV. Visual outcomes after carotid reconstructive surgery for ocular ischemic. *Eye (Lond)* 2012;**26**:1281–7.
- 2 Kawaguchi S, Okuno S, Sakaki T, Nishikawa N. Effect of carotid endarterectomy on chronic ocular ischemic syndrome due to internal carotid artery stenosis. *Neurosurgery* 2001;**48**:328–32.
- 3 Balcer LJ, Galetta SL, Yousem DM, Golden MA, Asbury AK. Pupil-involving third-nerve palsy and carotid stenosis: rapid recovery following endarterectomy. *Ann Neurol* 1997;**41**:273–6.
- 4 Marx JL, Hreib K, Choi IS, Tinvan T, Wertz FD. Percutaneous carotid artery angioplasty and stenting for ocular ischemic syndrome. *Ophthalmology* 2004;**111**:2284–91.
- 5 Kawaguchi S, Sakaki T, Iwahashi H, Fujimoto K, Iida J, Mishima H, et al. Effect of carotid artery stenting on ocular circulation and chronic ocular ischemic syndrome. *Cerebrovasc Dis* 2006;**22**:402–8.
- 6 Vos JA, van Merkm MH, Bistervels JH, Ackerstaff RG, Tromp SC, van der Berg JC. Retinal embolization during carotid angioplasty and stenting: periprocedural data and follow-up. *Cardiovasc Intervent Radiol* 2010;**33**:714–9.
- 7 Yamasaki H, Matsubara S, Sasaki I, Nagahiro S. Retinal artery embolization during carotid angioplasty and carotid artery stenting: case report. *Neurol Med Chir (Tokyo)* 2009;**49**:213–6.
- 8 Ackerstaff RG, Suttrop MJ, van den Berg JC, Overtom TT, Vos JA, Bal ET, et al. Prediction of early cerebral outcome by transcranial Doppler monitoring in carotid bifurcation angioplasty and stenting. *J Vasc Surg* 2005;**41**:618–24.
- 9 Tedesco MM, Lee JT, Dalman RL, Haukoos JS, Lane B, Loh C, et al. Postprocedural microembolic events following carotid surgery and carotid angioplasty and stenting. *J Vasc Surg* 2007;**46**:244–50.
- 10 Gupta N, Corriere MA, Dodson TF, Chaikof EL, Beaulieu RJ, Reeves JG, et al. The incidence of microemboli to the brain is less with endarterectomy than with percutaneous revascularization with distal filters of flow reversal. *J Vasc Surg* 2011;**53**:316–22.
- 11 Paraskevas KI, Lazaridis C, Andrews CM, Veith FJ, Giannoukas AD. Comparison of cognitive function after carotid artery stenting versus carotid endarterectomy. *Eur J Vasc Endovasc Surg* 2014;**47**:221–31.
- 12 Lopez OL, Jagust WJ, Dulberg C, Becker JT, DeKosky ST, Fitzpatrick A, et al. Risk factors for mild cognitive impairment in the Cardiovascular Health Study Cognition Study: part 2. *Arch Neurol* 2003;**60**:1394–9.
- 13 Purandare N, Burns A, Daly KJ, Hardicre J, Morris J, Macfarlane G, et al. Cerebral emboli as a potential cause of Alzheimer's disease and vascular dementia: case-control study. *BMJ* 2006;**332**:1119–24.
- 14 Vermeer SE, Prins ND, den Heijer T, Hofman A, Koudstaal PJ, Breteler MM. Silent brain infarcts and the risk of dementia and cognitive decline. *N Engl J Med* 2003;**348**:1215–22.
- 15 Vermeer SE, Hollander M, van Dijk EJ, Hofman A, Koudstaal PJ, Breteler MM. Rotterdam Scan Study. Silent brain infarcts and white matter lesions increase stroke risk in the general population: the Rotterdam Scan Study. *Stroke* 2003;**34**:1126–9.
- 16 ACST-2 Collaborative Group, Halliday A, Bulbulia R, Gray W, Naughten A, den Hartog A, Delmestri A, et al. Status update

and interim results from the Asymptomatic Carotid Surgery Trial-2 (ACST-2). *Eur J Vasc Endovasc Surg* 2013;**46**:510–8.

A.D. Giannoukas<sup>\*</sup>, K.I. Paraskevas  
*Department of Vascular Surgery, University Hospital of Larissa, Faculty of Medicine, School of Health Sciences, University of Thessaly, Larissa, Greece*

R. Bulbulia, A. Halliday  
*Nuffield Department of Surgical Sciences, University of Oxford, Oxford, UK*

<sup>\*</sup>Corresponding author. A.D. Giannoukas, Department of Vascular Surgery, University Hospital of Larissa, Faculty of Medicine, School of Health Sciences, University of Thessaly, Larissa, Greece.

Email-address: [giannouk@med.uth.gr](mailto:giannouk@med.uth.gr) (A.D. Giannoukas)

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