Journal of Neuroradiology (2013) **40**, 38—44

Available online at SciVerse ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

ORIGINAL ARTICLE

Carotid artery stenting in patients with symptomatic carotid stenosis: A single-center series

I. Kessler[a], B. Gory[b], F. Macian[c], G. Nakiri[b], M. Al-Khawaldeh[b], R. Riva[b], M.P. Boncoeur[c], C. Mounayer[b,*]

[a] *Department of Interventional Neuroradiology, University of Brasilia, Brasilia, Brazil*
[b] *Department of Interventional Neuroradiology, CHU Dupuytren, 2, avenue Martin-Luther-King, Limoges, France*
[c] *Department of Neurology, CHU Dupuytren, 2, avenue Martin-Luther-King, Limoges, France*

KEYWORDS
Carotid angioplasty stenting;
Carotid stenosis;
Stroke;
Cerebral protection device

Summary
Objectives: Carotid angioplasty with stenting (CAS) in patients with carotid stenosis (CS) has become more restricted in France especially since the disclosure of such studies as EVA-3S and Stent-supported percutaneous angioplasty of the carotid artery versus endarterectomy (SPACE). This report is of a series of CS cases contraindicated for endarterectomy that underwent CAS at a French center of interventional neuroradiology.
Patients and methods: Fifty-five patients with symptomatic CS more than 60% consecutively submitted to CAS between September 2008 and February 2011. The primary endpoint was either death or stroke within 30 days of the procedure; a secondary goal was to identify any possible factors that might have influenced the success and outcome of the intervention.
Results: The overall periprocedural stroke/death rate at 30 days was 5.4% (three out of 55 patients), with three non-disabling strokes and no deaths. Twenty-seven patients (49.1%) were treated with a cerebral protection device (CPD). Stent placement was achieved in all cases. Open- and closed-cell stents were implanted in 40 (72.7%) and 15 procedures (27.3%), respectively. Neither the use of a CPD, the carotid stent cell design nor any anatomical or technical factors were associated with a lower risk of stroke or death within 30 days of CAS.
Conclusion: CAS in symptomatic patients with CS contraindicated for endarterectomy in this selected French series proved feasible and safe, with acceptable levels of morbidity. Use of a CPD, type of stent (open- or closed-cell), and anatomical and technical factors had no influence on the success of the procedure or the outcome within 30 days of the operation.

* Corresponding author. Tel.: +33 55 50 58 011; fax: +33 55 50 56 288.
E-mail address: cmounayer@hotmail.com (C. Mounayer).

0150-9861/$ – see front matter © 2012 Elsevier Masson SAS. All rights reserved.
doi:10.1016/j.neurad.2012.03.003

Introduction

Percutaneous carotid artery stenting (CAS) represents a minimally invasive and less traumatic alternative to conventional surgical repair for managing carotid stenosis (CS) in selected patients, particularly those with significant co-morbidities or an inappropriate neck due to previous surgical procedures or radiation [1,2]. For this reason, CAS has become an important alternative to endarterectomy with few perioperative complications in some single-center series [3]. On the other hand, distal embolization of plaque fragments to the brain has generated considerable concerns over the safety of the procedure [4]. Moreover, studies such as the endarterectomy versus angioplasty in patients with symptomatic severe CS (EVA-3S) [5] and the Stent-supported percutaneous angioplasty of the carotid artery versus endarterectomy (SPACE) [6] trials have reported significant periprocedural death and stroke rates of 9.6% and 7.6%, respectively [7], within 30 days of the operation. These results have had an impact on the French public-health services, with more restrictions placed on performing carotid interventions in the guidelines for CAS published in 2007 by the French National Health Authority (*Haute Autorité de santé* [HAS]) [8]. Nevertheless, many factors, including patient eligibility criteria, unfavorable vascular anatomy, use of antiplatelet therapy, preoperative dilatation, the type of stent chosen (open- or closed-cell) and use of a cerebral protection filter, may influence the success and outcome of CAS [9,10].

The present retrospective study reports the experience of a single French center, after the publication of the EVA-3S results, of a series of 55 patients who underwent CAS, and describes the immediate results and potential outcome variables involved at 30 days postprocedure.

Patients and methods

Patient selection

Between September 2008 and February 2011, 55 consecutive patients who presented with a symptomatic carotid artery stenosis were treated using the CAS technique. Patients were considered symptomatic if they had ipsilateral amaurosis, or transient or persistent focal symptoms thought to be caused by cerebral ischemia. Inclusion criteria were restricted to patients contraindicated for carotid endarterectomy (CEA), and those considered to have high operative risks due to restenosis after CEA or CAS, anatomical variants (AV) with stenosis located in the submandibular region or near the skull base, contraindications for general anesthesia, stenosis after radiation or neck surgery, proximal or distal tandem stenosis and contralateral total carotid artery occlusion.

Each patient signed an informed consent form, and the local ethics committee approved the study. All eligible cases were selected by a multidisciplinary group, comprising a neurologist, a neurointerventional radiologist and a vascular surgeon. All patients underwent examination by a neurologist before and after the procedure.

Preprocedural evaluation

The carotid lesion was initially revealed by Doppler ultrasonography. Full angiographic perfusion scores, including selective catheterization of the bilateral common carotid arteries and vertebral arteries, were obtained before each procedure (Integris, Philips Healthcare, Best, The Netherlands). The degree of stenosis was reevaluated using three-dimensional (3D) acquisition and reconstruction. The degree of cervical stenosis before stent placement was quantified using the North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria [11].

Antithrombosis protocol

All patients were premedicated with daily doses of 160 mg of aspirin and 75 mg of clopidogrel for at least 5 days prior to the procedure. Biological testing was also systematically performed before the procedure (VerifyNow, Accumetrics Inc., San Diego, CA, USA). If platelet inhibition was deemed insufficient, then antiplatelet therapy was initiated. Following the procedure, patients continued to take 160 mg/day of aspirin indefinitely and 75 mg/day of clopidogrel for at least 3 months. During the intervention, an intravenous bolus of 5000 IU of heparin was administered immediately after sheath placement.

Carotid artery stenting procedure

All treatments were performed by the same interventional neuroradiologist (C.M.). Of the 55 procedures, 42 (76.4%) were performed in awake patients, thereby permitting careful clinical assessment at each step, while 13 (23.6%) were performed under general anesthesia when patients were uncooperative or the proximal anatomy was difficult and tortuous (Table 1).

A femoral approach was used in 53 patients, and a brachial approach in the remaining two. The 5-F diagnostic catheter (Terumo Corporation, Tokyo, Japan) was exchanged for a long 6-F introducer sheath (Destination, Terumo Corporation). The catheters were advanced into the common carotid artery, and 0.035- or 0.038-inch stiff wires were placed in the external carotid artery. In cases of sinuous common carotid arteries, a 4-F multipurpose 125-cm diagnostic catheter (Cordis Corporation, Miami Lakes, FL, USA) was placed in the long introducer in a triaxial arrangement to allow adequate placement of the long introducer.

Using a road-mapping technique, the stenosis was initially crossed by a 0.014-inch guide wire. In the case of stenosis less than 90%, a cerebral protection device (CPD; Spider RX, ev3, Plymouth, MN, USA) was deployed in the petrous portion of the internal carotid artery. In patients in whom a tight stenosis could not be passed with the stent-delivery system, predilatation with a 3.0-mm angioplasty balloon (Gateway, Boston Scientific, Natick, MA, USA) was performed before stenting. A self-expandable stent — either the carotid WALLSTENT (Boston Scientific) or Protégé (ev3) — was then advanced over the immobilized guide wire or filter wire. The choice of stent type (open- or closed-cell) was determined according to availability and operator decision, and was not intentionally driven