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ORIGINAL ARTICLE

Early versus late carotid artery stenting for symptomatic carotid stenosis

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KEYWORDS
Carotid artery angioplasty stenting;
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Summary
Introduction: Early carotid revascularization (≤14 days) is recommended for symptomatic carotid stenosis. Carotid artery stenting (CAS) has become an alternative to carotid endarterectomy (CEA); however, safety data on early CAS is controversial. The study aims to compare early versus late CAS, when CAS is performed as a first intention revascularization strategy.
Methods: A retrospective analysis of all symptomatic patients admitted to our stroke unit who underwent CAS was conducted. Patients were divided between two groups: patients who had undergone CAS within 14 days after symptoms and those who had undergone CAS later. Primary endpoints were ipsilateral ischemic stroke or ipsilateral parenchymal hemorrhage (iPH) at 30 days. The secondary endpoints were major adverse cardiac and cerebrovascular events (MACCE) at the 30-day and at the 12-month follow-up.
Results: One hundred twenty-seven consecutive patients were evaluated. Primary endpoints obtained in the early and late CAS groups were, respectively, ipsilateral stroke (2.0% vs. 2.6%, $P=1.00$) and iPH (2.0% vs. 0.0%, $P=0.40$). The rates of MACCE between the early and the late CAS groups were, respectively, (7.8% vs. 2.6%, $P=0.21$) at the 30-day follow-up, and (12.2% vs. 10.5%, $P=0.77$) at the 12-month follow-up.

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Conclusions: In this study, CAS seems to be safe when used as first intention revascularization treatment within 2 weeks of symptoms, if infarcted area is less than one third of the middle cerebral artery territory. Our results need to be confirmed by larger studies.

Introduction

Carotid artery stenting (CAS) is an emerging revascularization alternative to the standard carotid endarterectomy (CEA) [1—3]. The current guidelines recommend carotid revascularization for symptomatic carotid stenosis within the first 2 weeks after a non-disabling ischemic symptom [1,2]. It is noteworthy that that statement was based on an analysis of pooled data from CEA trials [4,5]. Although CAS has been indicated as an alternative to CEA [1—3], safety outcome data regarding CAS within the first 2 weeks of ischemic symptom onset remains controversial [6—10]. The present study aims to compare early versus late CAS as a first intention revascularization strategy for symptomatic patients admitted at our institutional stroke unit.

Materials and methods

Study design and patient population

This is a single-center retrospective study. The study protocol conformed to generally accepted scientific principles and the research ethics standards of our institution and was approved by the ethics committee (number: 20977113.0.0000.5440). Our institutional review board waived the need for written informed consent from the participants.

We retrospectively assessed radiological and clinical data on patients presenting symptomatic carotid artery atherosclerotic stenosis who underwent CAS from July 2010 to December 2012. All patients evaluated by our institutional stroke team presenting internal carotid artery stenosis $\geq$ 50% in a carotid ultrasound (US) underwent a computed tomography angiography (CTA) or a 3 T magnetic resonance angiography (MRA). Patients were evaluated for CAS as a first intention revascularization treatment if the inclusion and exclusion criteria were fulfilled (Table 1) [11]. Patients were divided between two groups: the first group consisted of patients who had undergone CAS within 14-days after ischemic symptoms (early CAS group), and the second group of patients who had undergone CAS later than 14 days after ischemic symptoms (late CAS group). Data on patients who had not undergone CAS was not collected.

The primary endpoints were incidence of ipsilateral ischemic stroke or ipsilateral parenchymal hemorrhage (iPH) at the 30-day follow-up. Secondary endpoints consisted of major adverse cardiac and cerebrovascular events (MACCE) at the 30-day and at the 12-month follow-ups. MACCE are defined as any stroke, symptomatic myocardial infarction, vascular complications or death. Other secondary endpoints included ipsilateral TIA, ipsilateral stroke, and iPH between 1-month and 12-month follow-ups.

CAS procedure

All procedures were performed by the interventional neuroradiology team of our institutional stroke team, which is formed by training fellows and staff. The CAS procedure protocol was the same that had already been published [12]. We used cerebral embolic protection devices, whenever possible. The antiplatelet regimen recommended was aspirin (300 mg daily) and clopidogrel (75 mg daily) at least five days before treatment or aspirin (300 mg attack) and clopidogrel (300 mg attack) at least four hours before the procedure and continuing for three months afterward. Aspirin 300 mg daily was maintained indefinitely. When an anticoagulant was indicated for secondary stroke prevention only aspirin 300 mg daily was recommended in combination with the anticoagulant drug, and clopidogrel was not indicated. After femoral punctures, 7500 IU of heparin bolus was administered intravenously for all patients. The procedures were performed with patients under local anesthesia with conscious sedation or under general anesthesia at the discretion of anesthesiology team. The hemodynamic monitoring followed recommendations of a previous published protocol on CAS [13]. All patients were discharged 24 h after treatment if no contra-indication occurred.

Clinical and radiological assessment

All patients were examined by independent certified vascular neurologists in-hospital, at the 1-month and at the 12-month follow-ups. The neurologists measured the neurological deficit and outcomes using validated Portuguese versions of the NIHSS and the modified Rankin Scale (mRS) [14]. The mRS scores were obtained at hospital admission, 1 month after treatment, and at the 12-month follow-up. A stroke was defined as an ischemic neurologic deficit (NIHSS' score $\geq$ 4) or aphasia that persisted for more than 24 h, and TIA was defined as an ischemic neurologic deficit (NIHSS' score $\geq$ 4) or aphasia that persisted for less than 24 h. The patients, who were not at the follow-up, were contacted by means of phone calls. A carotid ultrasound (US) was obtained at admission, at the 3-month, at the 6-month, and at the 12-month follow-ups.

Statistical analysis

Categorical variables were presented as numbers and percentages and compared among groups using Chi^2 or Fisher