Stroke Patterns of Internal Carotid Artery Dissection in 40 Patients

Christian Lucas, MD; Thierry Moulin, MD; Dominique Deplanque, MD; Laurent Tatu, MD; Didier Chavot, MD; and the DONALD Investigators*

Background and Purpose—Internal carotid artery dissection (ICAD) is a frequent cause of ischemic stroke in young patients. Whether cerebral ischemia is of embolic or hemodynamic origin remains to be determined. Heparin is often administered in ICAD; however, a drug trial can hardly be conducted because of the low recurrence rate after the acute stage. Therefore, the best therapeutic approach should be determined on the basis of the presumed mechanism of cerebral ischemia. One way to approach the mechanism of stroke in ICAD is to determine stroke patterns. We postulated that most cortical and large subcortical infarcts (≥15 mm) are of embolic origin and that small subcortical infarcts (<15 mm) and junctional infarcts are not. The aim of our study was to determine the stroke patterns in 40 consecutive patients with ICAD.

Methods—The patients (26 women and 14 men; mean age, 42.8 years) had a total of 65 ICADs. Seventeen patients were free of any vascular risk factor. CT scans, MRI scans, and angiographic features were analyzed by observers who were blinded to the clinical findings.

Results—We found 34 cortical infarcts, 25 large subcortical infarcts, 1 small subcortical infarct, and 5 junctional infarcts.

Conclusions—Most infarcts related to ICAD are cortical infarcts or large subcortical infarcts; small subcortical infarcts and junctional infarcts are infrequent. Therefore, these findings suggest that most infarcts occurring in carotid artery dissection (CAD) are probably embolic rather than hemodynamic in origin. According to this presumed mechanism, anticoagulation seems a logical treatment at the early stage of CAD. (Stroke. 1998;29:2646-2648.)

Key Words: cerebrovascular disorders ■ dissection ■ internal carotid artery ■ stroke ■ stroke classification

Received April 28, 1998; final revision received September 10, 1998; accepted September 18, 1998.

From the Departments of Neurology and Neuroradiology, Lille (C.L., D.D.) and Besançon (T.M., L.T., D.C.) University Hospitals, France.

*Clinical Investigators: D. Leys, MD; F. Mounier-Vehier, MD; C. Daems, MD; O. Godefroy, MD, PhD; H. Hénon, MD; D. Guerouaou, MD; T. Stoijkovic (Department of Neurology, University of Lille); L. Rumbach, MD (Department of Neurology, University of Besançon). Neuroradiological Investigators: J.P. Pravo, MD; X. Leclerc, MD; G. Soto Ares, MD (Department of Neuroradiology, University of Lille); F. Cattin, MD; J.F. Bonneville, MD (Department of Neuroradiology, University of Besançon).

Reprint request to: Christian Lucas, MD, Clinique Neurologique, Service de Neurologie Vasculaire, Hôpital Roger Salengro, CHRU de Lille, 59037 Lille Cedex, France. E-mail: clucas@chu-lille.fr

© 1998 American Heart Association, Inc.

Stroke is available at http://www.strokeaha.org

2646
TABLE 1. Epidemiological Data in the Study Population of 40 Patients With Internal Carotid Artery Dissection

<table>
<thead>
<tr>
<th>Epidemiological Data</th>
<th>N = 40 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men/women</td>
<td>14/26</td>
</tr>
<tr>
<td>Arterial hypertension</td>
<td>11 (27.5)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1 (2.5)</td>
</tr>
<tr>
<td>Dyslipemia</td>
<td>9 (22.5)</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>14 (35)</td>
</tr>
<tr>
<td>Migraine</td>
<td>7 (17.5)</td>
</tr>
<tr>
<td>Migraine with ophthalmic aura</td>
<td>3 (7.5)</td>
</tr>
<tr>
<td>No vascular risk factors</td>
<td>17 (42.5)</td>
</tr>
<tr>
<td>Recent cervical trauma</td>
<td>12 (30)</td>
</tr>
</tbody>
</table>

Results

The study population consisted of 26 women and 14 men, aged 18 to 61 years (mean age, 42.8 years; 95% CI, 39.2 to 46.3). Patients had a total of 45 ICA dissections (26 right, 19 left). Five patients had bilateral ICA dissections; of these 5 patients, 2 had a bilateral ICA dissection with unilateral vertebral artery dissection, and 1 had a dissection of both the ICA and the vertebral artery.

Seventeen patients were free of any vascular risk factor (Table 1). Seven patients had a history of preexisting migraine according to International Headache Society criteria, including 3 with ophthalmic aura. A recent cervical trauma (either trivial, such as from carrying a heavy burden, dancing, or painting a ceiling, or obvious, such as chiropractic maneuvers or a car accident) was found in 12 patients. ICAD was associated with headache in 8 patients, cervical pain in 3, and both headache and cervical pain in 6 patients. Eight patients had a Horner’s syndrome (2 isolated, 3 with cervical pain, and 3 with headache). We found 24 stenoses (12 right, 12 left), with 20 string signs and 21 occlusions (14 right, 7 left) at the acute phase. Eleven patients had dysplasia, and 9 had a pseudoaneurysm on the ICA (6 on the right ICA and 3 on the left). A second angiography performed 3 months later in 33 patients showed persistence of the same abnormality in 9, partial reopening in 2, and complete angiographic recovery in 22.

The patients had a total of 65 infarcts (Table 2). All were recent infarcts, except in 1 patient, who had a recent infarct in the left hemisphere due to left occluded carotid artery dissection and an old infarct on the right side, without evidence of old carotid artery dissection or dysplasia. All infarcts were located in the territory of the dissected carotid artery except for the previous patient. We found 34 cortical hemispheric infarcts, 25 subcortical infarcts >15 mm, 1 subcortical infarct <15 mm, and 5 junctional or watershed infarcts. The 5 junctional or watershed infarcts were isolated, and 3 of the 5 were associated with a homolateral occluded carotid artery. There were no differences in the breakdown of stroke patterns according to the stenotic or occlusive angiographic feature (2 large cortical or subcortical infarcts in patients with occlusion and 28 in those with stenosis; 3 junctional or watershed infarcts in patients with occlusion and 2 in those with stenosis), except for multiple infarcts. We found 13 patients with multiple infarcts. Patients with multiple infarcts had mainly occlusions (9 patients) rather than stenoses (4 patients). Therefore, cortical infarcts and subcortical infarcts accounted for 92.2% of all infarcts, whereas junctional infarcts accounted for only 7.7%.

Discussion

Our study showed that most infarcts related to ICAD are cortical or large subcortical infarcts. Epidemiological and clinical data are similar to those of the literature except for the sex ratio. We found a strong predominance of women (65%). This result also could explain why we found 11 dysplasia aspects (27.5%) on initial angiography. According to the current conception of the relationship between the mechanism of infarction and stroke patterns, cortical or subcortical infarcts are more likely to be of embolic origin, whereas junctional or watershed infarcts are more likely to be of hemodynamic origin. Using this simplification, we found that only 7.7% of patients with CAD had a...
presumed hemodynamic cerebral ischemia, whereas 92.2% had a presumed embolic infarct. However, even if this simplification provides an easy approach of the presumed mechanisms of cerebral ischemia in most patients, one should bear in mind that at the individual level, junctional infarcts are sometimes associated with a possible embolic mechanism. Therefore, we have probably overestimated the rate of hemodynamic infarcts in our study. Despite this overestimation, the number of patients with presumed hemodynamic infarcts is extremely low (7.7%). Our study therefore supports the hypothesis that most infarcts in ICAD are of embolic origin. On the other hand, the 2 pathophysiological mechanisms are probably linked. Indeed, we can easily imagine that in the first step of an ICAD, the hemodynamic mechanism is prominent during the constitution of the wall hematoma, whereas the embolic mechanism is prominent after this phase. We found that patients with occlusion primarily had multiple infarcts, also suggesting an embolic mechanism. However, it is difficult to reach a conclusion concerning this finding, because carotid artery dissection is a dynamic process at the acute phase and some occlusions can return to stenosis very quickly. In the study of Weiller et al, the authors reported a similar frequency of embolic and hemodynamic infarcts, but their study population consisted of only 11 patients. We reached the same conclusion as Steinke et al, who showed that 37 of 67 patients (55%) with ICA dissection had brain infarcts, of which territorial artery MCA infarcts of variable size accounted for 60%; large laterostriate infarcts were present in 11%, and a presumed hemodynamic mechanism was found in only 16% of infarcts. A thrombus formation in the dissected artery with secondary distal embolism is the most likely mechanism of cerebral infarction in CAD. Evidence of distal emboli is rare because of the widespread use of heparin at the acute phase of ischemic stroke, especially in young patients, and because of the limitations of angiography. In the study of Steinke et al, the autopsy of a patient who died of an MCA infarct provided arguments for an embolic mechanism: all large MCA branches were occluded by a recent thrombus originating from an intimal tear 4 cm distal to the right carotid bifurcation. This study therefore suggests a prominent embolic origin in patients with ICAD and ischemic stroke.

Acknowledgment
This study was supported by the Association Pour la Recherche et l’Enseignement en Pathologie Neurovasculaire (APREPAN).

References
Stroke Patterns of Internal Carotid Artery Dissection in 40 Patients
Christian Lucas, Thierry Moulin, Dominique Deplanque, Laurent Tatu and Didier Chavot
the DONALD Investigators

Stroke. 1998;29:2646-2648
doi: 10.1161/01.STR.29.12.2646
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1998 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://stroke.ahajournals.org/content/29/12/2646

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published
in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office.
Once the online version of the published article for which permission is being requested is located, click
Request Permissions in the middle column of the Web page under Services. Further information about this
process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org//subscriptions/