Spontaneous Recanalization of Internal Carotid Artery Occlusion

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Background and Purpose—Spontaneous recanalization of an acutely occluded internal carotid artery (ICA) is an important phenomenon, the natural history and incidence of which have been incompletely studied. Although conventional catheter arteriography remains the gold standard for distinguishing total arterial occlusion from hairline residual lumen, CT angiography (CTA) is able to make this distinction noninvasively and more sensitively than either unenhanced MR angiography or ultrasound. The purpose of this report is to raise awareness of spontaneous recanalization and to demonstrate the possible use of CTA in following up cases of ICA occlusion.

Methods—We describe here 2 cases of acute cervical ICA occlusion seen on CTAs done at our institution.

Results—Follow-up CTAs in both cases showed spontaneous recanalization of the ICA requiring ipsilateral carotid endarterectomy within 1 month of the initial presentation.

Conclusions—CTA, an accurate, rapid, and less invasive modality than conventional catheter arteriography, can be used to serially monitor anticoagulated patients with new-onset ICA occlusion for potential spontaneous vascular recanalization. The ability to conveniently assess ICA patency not only may influence management of individual patients but also could help us better establish the true incidence of spontaneous carotid recanalization in future studies.

Key Words: angiography ■ carotid artery occlusion ■ recanalization

Although probably not frequent, spontaneous recanalization of occluded internal carotid arteries (ICAs) has been previously observed and reported.1–3 Because, however, the diagnosis of recanalization has historically required the performing of a conventional catheter arteriogram, an invasive procedure with attendant nontrivial safety considerations, the incidence and natural history of spontaneous recanalization have not been well established. Indeed, our literature review reveals few relevant reports more recent than 20 years old.1–4 The frequency with which spontaneous recanalization has been reported has varied greatly in these prior studies, as were the intervals between the baseline and follow-up arteriograms. The exact timing of spontaneous recanalization remains unclear. In 1969, Fieschi and Bozzao1 noted the “disappearance” of distal ICA occlusion on follow-up angiograms obtained 2 to 3 weeks after initial presentation. More recently, the existence of very early spontaneous recanalization, within 1 to 2 hours of onset, has also been reported.4 The mechanism of the recanalization, whether it occurs early or late, is also unclear. Regardless of the underlying mechanism, diagnosing recanalization is potentially important in establishing prognosis, assessing current treatment, and determining the future course of treatment.

The current gold standard for imaging of cerebral arteries is digital subtraction arteriography, most commonly performed via a transfemoral arterial approach. This invasive technique carries a complication rate as high as 5%, with a risk of permanent stroke in up to 0.5%.3,5 CT angiography (CTA) is a rapid, safe, and minimally invasive method that has been shown to be highly sensitive and specific in diagnosing severe carotid stenosis and occlusion.6,7 In preliminary studies, CTA has also been shown to be highly accurate in distinguishing hairline residual ICA lumen (“string sign”) from a true total vascular occlusion.8–11 In this article, we report 2 cases of extracranial ICA occlusion that were followed up by serial CTA examinations, each of which developed spontaneous ICA recanalization. In both cases, the CTA data influenced management, resulting in carotid endarterectomy.

Methods

Case Descriptions

Patient 1
A 70-year-old man with a history of hypertension, hypercholesterolemia, and right carotid endarterectomy (~1 year earlier) was admitted for recurrent right ICA stenosis. The day before admission, he had difficulty buttoning his shirt. On admission, a catheter cerebral arteriogram with late venous phase images (Figure 1A) showed a totally occluded right ICA, beginning at the bifurcation. Immediately after the procedure, the patient was noted to have a left facial droop with severe left-sided weakness. He was started immediately on intravenous heparin; emergent head CT scan and CT

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angiogram of the head and neck were performed, which confirmed the right ICA occlusion (Figure 1B) and revealed a new, acute right M1 distribution infarction. The patient’s status improved significantly over the next few days, and he was discharged on coumadin to a rehabilitation facility.

A follow-up carotid ultrasound, performed 3 weeks after the initial admission, suggested that the right ICA may have recanalized. This was confirmed by a repeated CT angiogram (Figure 1C). The patient was readmitted for a right carotid endarterectomy.

**Patient 2**
A 64-year-old man with a history of bilateral carotid endarterectomy 10 years earlier, long-term smoking, and uncontrolled hypercholesterolemia presented to an outside hospital with mild right-sided hemiparesis and dysarthria. He was placed on intravenous heparin and transferred to our institution for further evaluation. On examination, he was awake and alert with only mild right-sided weakness.

Before admission, a catheter cerebral arteriogram showed a left ICA occlusion (Figure 2A). Admission CT angiogram of the head and neck confirmed the occlusion of the left ICA, beginning at the bifurcation (Figure 2B), with severe stenosis near the origin of the right ICA (residual lumen diameter <1.5 mm). He was maintained on intravenous heparin. Repeated CT angiogram performed 3 days after admission demonstrated spontaneous recanalization of the left ICA (Figure 2C), a new left lenticular nucleus stroke, and an old left frontal infarct. Left carotid endarterectomy was performed 2 days later.

**Results**
Both patients had lumenal patency of the ICA as observed by the surgeons at the time of their endarterectomies. Pathology results of the lesions were consistent with atherosclerotic plaque with an organizing thrombus.

**Discussion**
Spontaneous recanalization of acutely occluded cerebral and carotid arteries is not a rare phenomenon. Several small series have reported the occurrence of recanalization of an occluded ICA between 6 hours and 2 weeks after the documentation of occlusion. In these reports, the occlusions were followed with serial conventional catheter arteriograms. In our patients, the interval between diagnosis of occlusion and its resolution was 24 days for patient 1 and 3 days for patient 2. The frequency of recanalization has been reported to be anywhere from 17% to 67%, which appears to increase with increased time between initial occlusion and follow-up arteriogram.12,13

Although many clinicians are hesitant to put patients through repetitive invasive procedures such as catheter arteriograms, CTA has been proved in several studies to be a rapid, safe, minimally invasive, and highly accurate method for the detection of severe carotid disease.7 CTA axial images have been found to have a sensitivity of 100%, a specificity of 98%, and an accuracy of 99% for diagnosing ICA occlusion. Moreover, preliminary studies have demonstrated the high accuracy of CTA in distinguishing a small but patent ICA lumen (hairline residual lumen) from true total occlusion.8–12 In both of our patients, occlusion and recanalization were diagnosed by serial CTA of the neck, with partial catheter arteriographic and ultrasound correlation. Neither patient experienced any complications from the CTAs. The results were further confirmed by their surgeries, which revealed that both patients had intraluminal patency of their vessels.

Several mechanisms, including vasospasm, distal embolization of occlusive clot, and spontaneous clot lysis, have been proposed to explain recanalization. Although both of our patients were treated with intravenous heparin from the onset, it is not known what role, if any, antplatelet and anticoagulant therapy may have in the process of recanalization. The presence of fresh thrombus on both of our patients’ surgical
specimens suggests that there might have been some autolysis that could explain the recanalization. Another possible explanation for “spontaneous” recanalization is that the vessel was never completely occluded in the first place and that the “occlusion” seen on CTA images was the result of extremely slow flow. To minimize this possibility, all angiographic runs were carried out to the completion of the late venous phase through the distal extracranial ICA and through the entire intracranial ICA in cases of possible occlusion. Furthermore, because curved, reformatted CTA images may potentially be false positive for occlusion, both the axial source images and the reconstructions are always carefully reviewed at consecutive levels to confirm that there is no flow-related enhancement. Therefore, the possibility of an artifactual ICA occlusion in these cases seems highly unlikely. We are confident that the absence of flow on CTA imaging in our cases reflects true rather than “pseudo” vascular occlusion.

In summary, we have described 2 cases in which the spontaneous resolution of occlusive ICA lesions was detected by CTA. The data supplied by CTA resulted in alteration of the therapeutic management of these patients. The natural history and incidence of spontaneous recanalization of an acutely occluded ICA, although probably not a rare occurrence, have not been well established in the literature. We believe that serial monitoring of such patients to identify potential surgical or stenting candidates may be warranted and that CTA is a safe and highly accurate method for this purpose. Clearly, further studies are needed to better determine the true incidence of recanalization and the optimal timing of follow-up examinations.

References
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