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CASE REPORT

Distinguishing Critical Stenosis from Occlusion of the Internal Carotid Artery by Carotid Duplex in a Patient with Acute Ischemic Stroke

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KEY WORDS
acute ischemic stroke,
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Accurate distinction of internal carotid artery (ICA) severe stenosis from occlusion in patients with acute stroke is crucial because carotid revascularization may reduce the risk of recurrent stroke. We report a 68-year-old man who had acute onset of right hemiparesis and hemiparesthesia. Head magnetic resonance imaging (MRI) on the first day and computed tomography (CT) angiography the next day showed total occlusion or pseudo-occlusion of the left ICA. However, carotid ultrasonography at around the same time clearly demonstrated focal severe stenosis of the left ICA orifice and catheter carotid angiography later confirmed the findings. The patient received angioplasty and stenting of the left ICA 3 weeks after stroke, and his follow-up course was uneventful. The case report highlights the value of carotid ultrasonography in distinguishing critical stenosis from occlusion of the carotid artery in patients with acute ischemic stroke.

Introduction

Accurate differentiation of severe stenosis from occlusion of the internal carotid artery (ICA) is not always easy [1], and the diagnosis may influence the treatment strategies. Revascularization, either via carotid stenting or endarterectomy, can effectively reduce the risk of stroke recurrence in patients with severe carotid stenosis [2]. For patients with carotid occlusion, bypass surgery may be considered in patients with hemodynamic insufficiency [3], but the efficacy is not well proven. Previous studies have demonstrated the superiority of magnetic resonance (MR) or computed tomography (CT) angiography over carotid duplex in diagnosis of ICA occlusion; therefore, patients

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who have ICA occlusion identified by MR or CT angiography may not receive a carotid duplex exam in clinical practice [4]. We report one acute ischemic stroke patient, with suspicious ICA occlusion on MR and CT angiography, who had severe focal stenosis identified by carotid duplex.

Case report

The 68-year-old man had dyslipidemia with statin treatment for 1 year. He presented to the emergency room with acute onset of right upper limb weakness and numbness. His right arm weakness got worse gradually, right leg clumsiness appeared, and acute stroke was suspected. Neurological examination at 8 hours after onset showed right central type facial palsy and right hemiparesis, being more severe on the upper limb. Head MRI with gadolinium enhancement showed acute infarction at the left posterior fronto-parietal areas and total occlusion of the ipsilateral ICA (Fig. 1A). Adequate hydration and anti-platelet agent were administered, but his right limb weakness progressed the following morning. Emergent CT angiography and perfusion scan showed probable pseudo-occlusion of the left ICA with perfusion insufficiency of the ipsilateral middle cerebral artery (MCA) and anterior cerebral artery (ACA) territories (Fig. 1B). Extracranial to intracranial (EC—IC) bypass surgery was then considered for the ICA occlusion with compromised cerebral hemodynamics. However, carotid ultrasonography 2 hours after CT angiography clearly demonstrated a severe focal stenosis of the ICA (Fig. 1C and 1D) with very high flow resistance of the ipsilateral common carotid artery (resistance index was 0.98 at the left side and 0.67 at the right side). The flow direction of the right ophthalmic artery (OA) was normal. Digital subtraction angiography (DSA) on the following day confirmed the results (Fig. 1E). His neurological condition stabilized thereafter and endovascular stenting was performed successfully 3 weeks after the onset of stroke with smooth follow-up course (Fig. 1F).

Discussion

It is well known that patients with symptomatic ICA severe stenosis have high risk of developing ipsilateral stroke with medical treatment only. Therefore, revascularization either by carotid stenting or endarterectomy has been recommended for any susceptible patient with symptomatic ICA stenosis [2]. Patients with symptomatic ICA occlusion are at high risk for recurrent stroke, especially for those with a compromised cerebral blood flow [5]. However, unlike ICA stenosis, endovascular recanalization for ICA total or pseudo-occlusion remains a technical challenge [6,7]. EC—IC bypass may improve cerebral hemodynamics in patients with ICA occlusion, but its effect on reducing the risk of recurrent stroke is still controversial [3].

For patients with acute stroke related to ICA stenosis or occlusion, stroke in evolution or recurrent stroke in acute stage is quite common and usually associated with deterioration of neurological status and poor functional outcome.

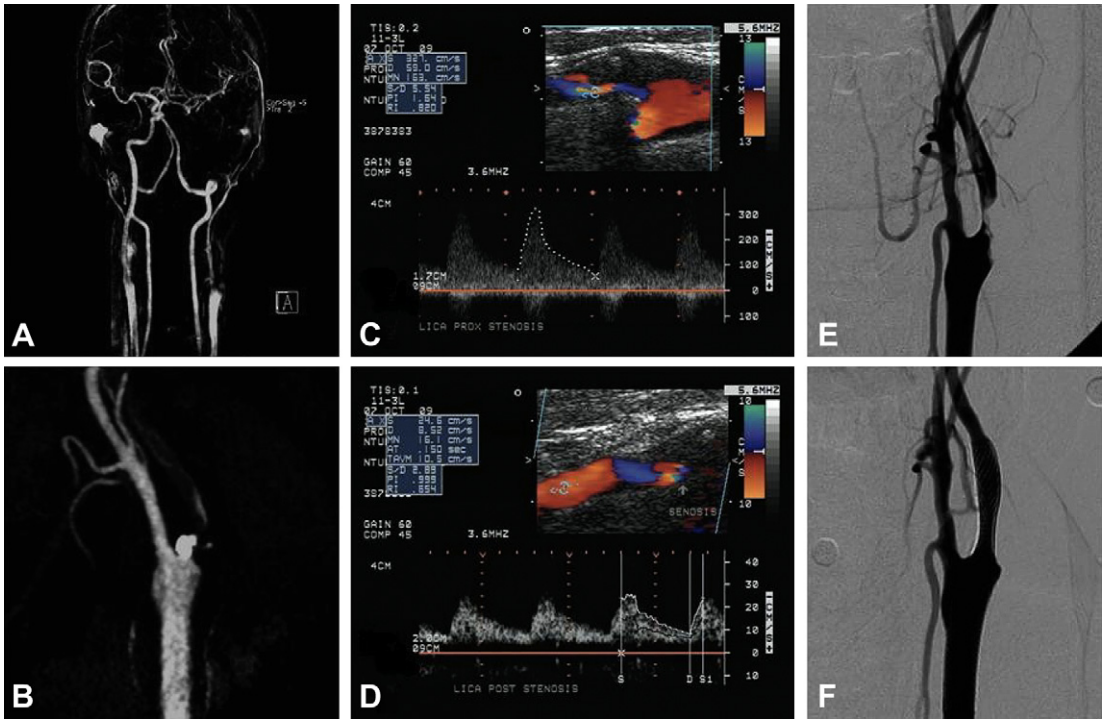

Fig. 1 Left proximal ICA occlusion or pseudo-occlusion was seen on head MR angiography (A) and CT angiography (B). Carotid duplex of the left ICA showed high flow velocity and resistance at the critical stenotic region (C) and low flow velocity and resistance at the post-stenotic region (D). Angiography confirmed the findings of ICA severe stenosis (E), and carotid stenting was performed smoothly 3 weeks after the onset of stroke (F). CT = computed tomography; ICA = internal carotid artery; MR = magnetic resonance.

Previous studies showed that the risk of recurrent stroke within 3 months after acute stroke may be as high as 20—30% with medical treatment only [8,9]. For these reasons, it is important to distinguish severe stenosis from occlusion of the ICA accurately and without delay for patients with acute stroke.

Today, MR or CT angiography is widely used as a noninvasive diagnostic imaging modality for ICA disease [4,10]. It has proven highly accurate for the diagnosis of high-grade ICA stenosis and occlusion. Therefore, many research centers and hospitals have already made the transition from invasive DSA to noninvasive MR or CT angiography as a sole imaging modality and determinant for the performance of surgical or endovascular intervention.

However, in our reported case, initial head MRI with contrast showed acute infarct at the left MCA territory infarct with total occlusion of the ipsilateral ICA. CT angiography performed the next day due to deterioration of neurological deficit showed probable pseudo-occlusion of the left ICA with compromised hemodynamics. EC—IC bypass was then considered for restoring inadequate perfusion of the ipsilateral MCA territory. Unexpectedly, carotid ultrasonography performed within a very short period after CT angiography clearly demonstrated a severe focal stenosis rather than occlusion of the ICA. DSA also confirmed the finding, and endovascular stenting was performed smoothly 3 weeks after the onset of stroke. Reviewing the entire course of his treatment, the patient could have received EC—IC bypass rather than endovascular stenting if carotid ultrasound exam had not been performed.

There are two important findings of the carotid ultrasound study in our reported case. The first finding is the very high flow resistance of the ipsilateral common carotid artery. This hemodynamic factor may have caused the injected contrast medium to systemically fail to show the critical stenotic and post-stenotic lumen of the ICA clearly, especially if time was not allowed for contrast opacification to occur in the arterial phase imaging procedure. According to previous studies, other possible factors attributing to the false recognition of MR or CT angiography include slow contrast bolus timing, inseparable early venous contrast phase from the arterial opacification, post-processing of the raw data, and motion effect [10,11]. The second finding is normal flow direction of the OA on the carotid duplex [12]. Although it is not rare to see normal flow direction of the OA in ICA occlusion, the percentage of reverse flow of OA in ICA occlusion is much higher than severe stenosis, thus clinicians should reconsider the accuracy of the diagnosis of ICA occlusion in patients if the OA flow direction is normal [13].

One possible limitation in our reported case is that spontaneous recanalarization may occur during the period between the CT angiography and the carotid ultrasound. However, in the situation where the ultrasound exam is performed within 2 hours after the CT angiography, the possibility of spontaneous recanalarization might be scant within such a short period [14]. However, even if recanalization of ICA had occurred in the short period between CT angiography and ultrasound, our case still demonstrated the usefulness of carotid ultrasound in determining optimal treatment of acute stroke patients with ICA diseases because ultrasound exam is much cheaper and more convenient than CT or MR angiography to be repeatedly performed at the bedside during the acute stage of stroke.

In conclusion, we would like to re-emphasize the importance of the carotid duplex in identifying ICA stenosis from occlusion in patients with acute stroke. Carotid ultrasound should be regarded as an important complementary diagnostic tool for any stroke patient with suspicious ICA occlusion.

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