



Pseudo-dissection of the internal carotid artery in acute ischemic stroke

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Imaging plays a central role in the diagnosis, triage and outcome of acute ischemic stroke cases; therefore a deep understanding of its modalities is necessary in order to positively impact patient care [1]. The aim of the present case is to illustrate a computed tomography angiography (CTA) flow artifact mimicking an internal carotid artery (ICA) dissection caused by a severe, proximal common carotid artery (CCA) stenosis and a subsequent external-to-internal carotid artery (ECA-to-ICA) steal phenomenon.

A 60-year-old male patient was brought to the emergency department with right-sided hemiparesis and aphasia, outside the time window for interventional therapy. Neurologic examination revealed a conscious patient, with grade 4 right-sided hemiparesis and mixed type of aphasia, with a National Institute of Health Stroke Scale score of 6.

Non-contrast CT showed no evidence of hemorrhage or ischemia. CTA of the head and neck was performed. A severe stenosis (99%) of the left CCA was discovered (Fig. 1a); a short, irregular, linear hypoattenuation was noted at the level of the left carotid bulb, regarded as a possible dissection flap (Fig. 1a); a more careful analysis revealed that the hypoattenuating flap was the result of two separate streams of contrast-opacified blood, one in the ICA, the other entering from the ECA, giving rise to a “vortex” appearance (Fig. 1e) which we termed the “angiographic

whirl sign”. The “vortex” appearance can be seen on axial source images while sliding through the slices. More cephalad, a central filling defect is seen in the horizontal petrous portion (Fig. 1c) extending along the entire intracranial ICA (not shown); proximal left M1 segment was patent, but other filling defects were identified in the anterior temporal artery and in the MCA distal to it (Fig. 1d), interpreted as possible floating thrombi.

Carotid Doppler ultrasonography was requested to assess the flow in the ICA (Fig. 2) Poststenotic, low-flow pattern was detected in the left CCA (Fig. 1b) and ICA (Fig. 1d) and ECA-to-ICA steal phenomenon (Fig. 1c).

The right extracranial ICA was normal on CTA images and there were no pathologic alterations on the Doppler ultrasound examination.

Catheter angiography of the supra-aortic vessels was conducted on a Siemens Artis Zee biplane system and digital subtraction angiography (DSA) images were obtained (Fig. 3) showing no evidence of dissection or floating thrombi; instead, the left ICA was patent (Fig. 3b), the ipsilateral MCA territory was supplied through the anterior communicating artery (ACom) (Fig. 3d) and posterior communicating artery (PCom) (not shown). Left VA injection revealed filling of the ICA through ECA via muscular branches of the occipital artery (Fig. 3c).

The second cerebral CT scan after 24 h revealed a deep watershed infarction in the left hemisphere (Fig. 4).

The patient presented regressive symptoms and was discharged 10 days later on antiplatelets and statins.

Pseudo-dissection (PD) of the ICA encountered at CT angiography represents a flow artifact, resembling a dissection flap or a “flame-shaped” occlusion, caused by altered hemodynamics in cases with proximal or distal vessel stenosis or occlusions. In such cases, flow alterations are the result of a slower-moving column of contrast-opacified blood that is outrun by the fast scanning protocol of 64 or higher detector-row CT, creating appearances like pseudo-dissections or pseudo-occlusions [2, 3]. A false dissection

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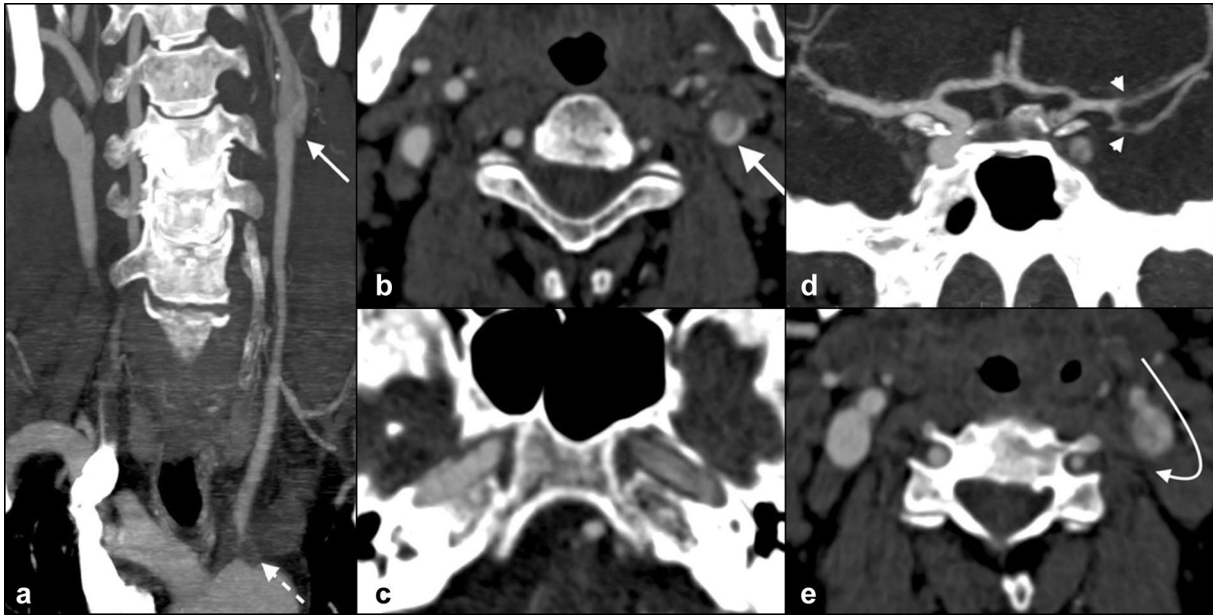


Fig. 1 Coronal and axial maximum intensity projection (MIP) reformatted images: **a** tight left common carotid artery stenosis (90–99%), most likely atherosclerotic in nature (white dashed arrow), followed by an irregular aspect of the artery and a linear hypodensity at the level of the carotid bulb (white arrow); **b** same hypodensity seen within the lumen of the left carotid bulb (white arrow); **c** central fill-

ing defect within the horizontal petrous segment of the left ICA; **d** filling defects seen in the left anterior temporal artery and left M1 segment of the middle cerebral artery (arrowheads); **e** contrast seen entering retrogradely through the external carotid artery into the carotid bulb—angiographic “whirl sign” (curved white arrow)

image can also be a consequence of flow reversal or flow separation at the level of the carotid bulb [4, 5]. In our case, the false dissection and subsequent ICA filling defects were caused by hemodynamic disturbances distal to a proximal CCA severe stenosis, which favored reversal of flow from the VA through the ECA and the development of an ECA-to-ICA steal syndrome evident on the ultrasound exam. This

to our knowledge is the first proof of a false dissection flap caused by this steal phenomenon.

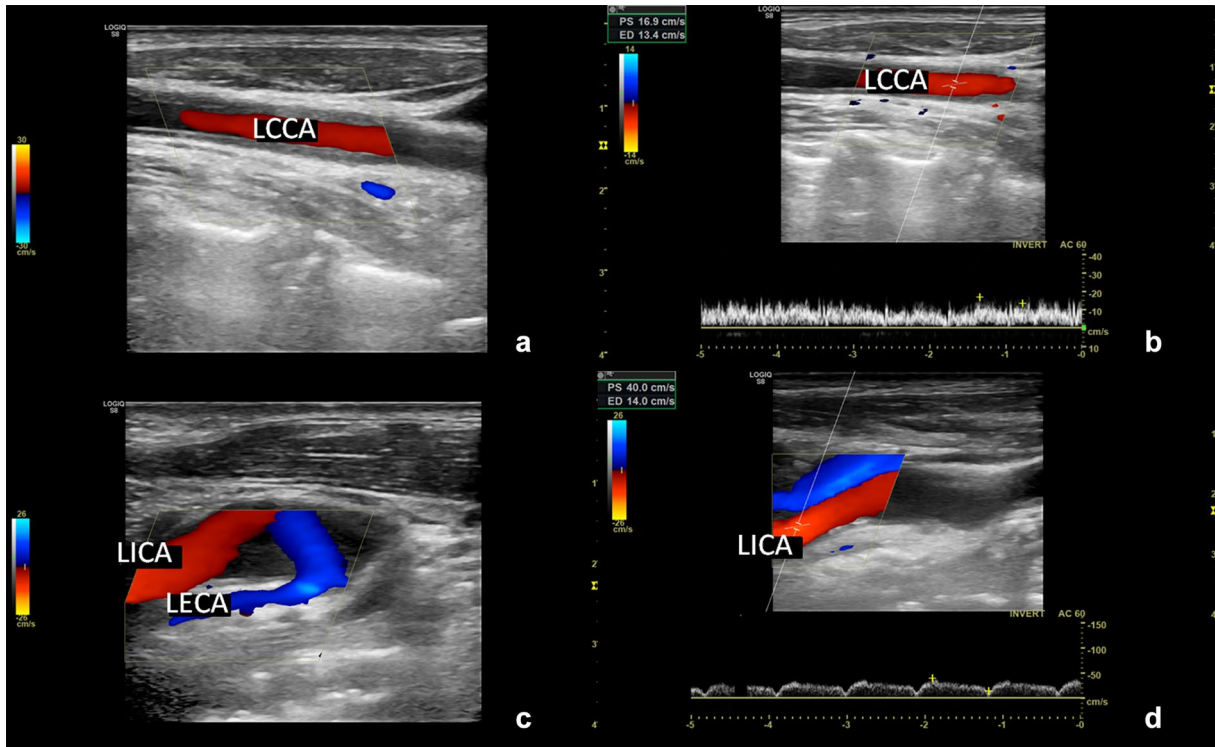


Fig. 2 Carotid ultrasound examination. **a** Duplex-mode examination revealing increased intima–media thickness and atherosclerotic changes in the left common carotid artery (LCCA); **b** triplex-mode examination showing poststenotic, turbulent, low-flow pattern in the

LCCA; **c** color mode examination—reversed flow in the left external carotid artery (LECA) and antegrade flow in the left internal carotid artery (LICA). **d** Triplex-mode examination—poststenotic low-flow pattern in the left internal carotid artery (LICA)

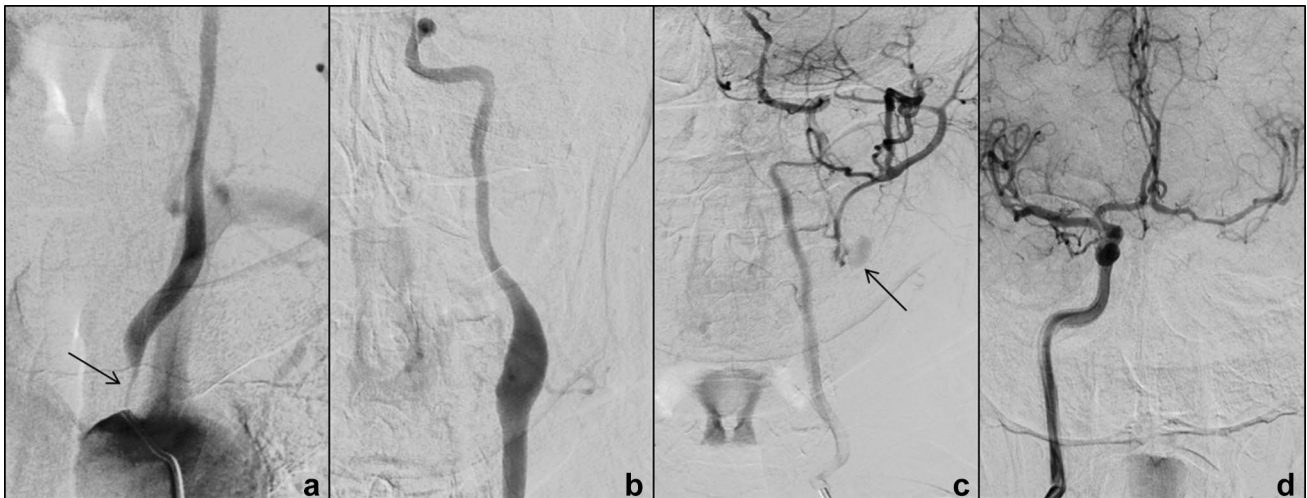
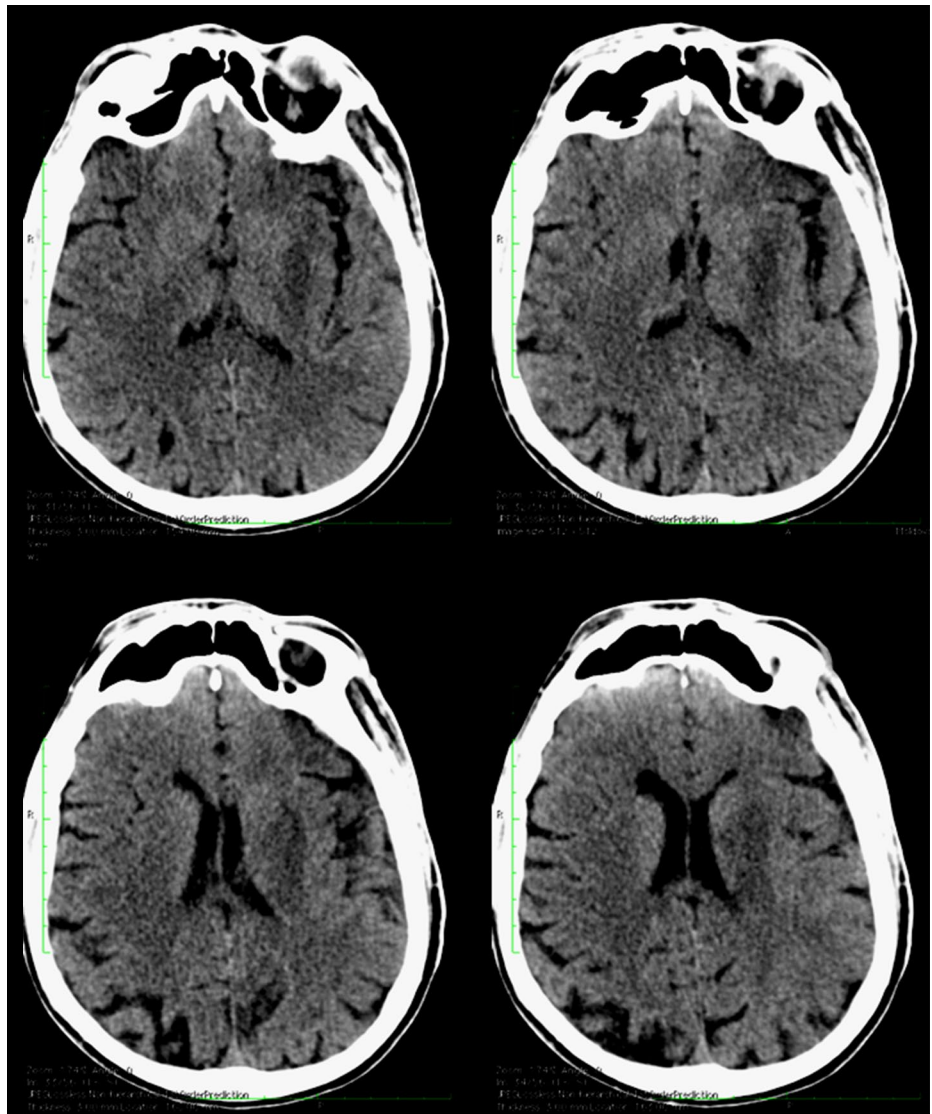


Fig. 3 Digital subtraction angiograms of the left CCA and ICA (**a, b**), left VA (**c**) and right ICA (**d**). **a** Tight CCA stenosis (black arrow); **b** patent left ICA without evidence of dissection; **c** retrograde filling

of the ICA from the left VA via collaterals from the occipital artery (black arrow); **d** left MCA territory supplied through ACom from right ICA

Fig. 4 Axial non-enhanced cerebral CT scan, revealing a deep watershed infarction in the left hemisphere



Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The authors certify that they comply with the Principles of Ethical Publishing.

Informed consent The authors certify that the patient reported here gave his informed consent.

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