Acute Ischemic Stroke – Cerebral Perfusion prior to and after Treatment

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History

A 74-year-old female patient, having had a sudden onset of unconsciousness 5 hours ago, was presented to the emergency department. The patient had a history of uncontrolled hypertension and cerebral ischemic stroke. An ECG revealed a paroxysmal atrial fibrillation. A non-contrast CT showed a slightly hypodense area in the right frontal and parietal lobes, suggesting an ischemic change. Volume perfusion CT was requested to further investigate the cause of the ischemia and the viability of the ischemic cerebrum.

Diagnosis

Non-contrast CT images showed a slightly hypodense area in the territory of the right middle cerebral artery (RMCA), with disappearance of the local sulci and the lateral sulcus, suggesting an ischemic stroke. Volume perfusion CT images showed a mismatch between the extent of reduced cerebral blood flow (CBF) and cerebral blood volume (CBV) suggesting the existence of a penumbra. Time to drain (TTD) and mean transit time (MTT) were increased, indicating delayed blood supply. CT angiography (CTA) images reconstructed from the thin slice perfusion data using *syngo*.CT Dynamic Angio (tMIP) showed an occlusion in the middle segment of the RMCA.

Examination Protocol

Scanner	SOMATOM AS+	
Scan area	Head	Head
Scan mode	Sequential	Adaptive 4D Spiral
Scan length	136.8 mm	96 mm
Scan direction	Caudal-cranial	Shuttle
Scan time	12 s	36 s
Tube voltage	120 kV	70 kV
mAs per image	294 mAs	100 mAs
Dose modulation	CARE Dose4D	NA
$CTDI_{vol}$	41.82 mGy	57.7 mGy
DLP	602 mGy cm	657 mGy cm
Rotation time	1.0 s	0.3 s
Slice collimation	60 × 0.6 mm	32 × 1.2 mm
Slice width	7.2 mm	1.5 mm
Reconstruction increment	7.2 mm	1.0 mm
Reconstruction kernel	H40s	H10f
Contrast		370 mg / mL
Volume	NA	40 mL + 40 mL Saline
Flow rate	NA	6 ml/s
Start delay	NA	5 s

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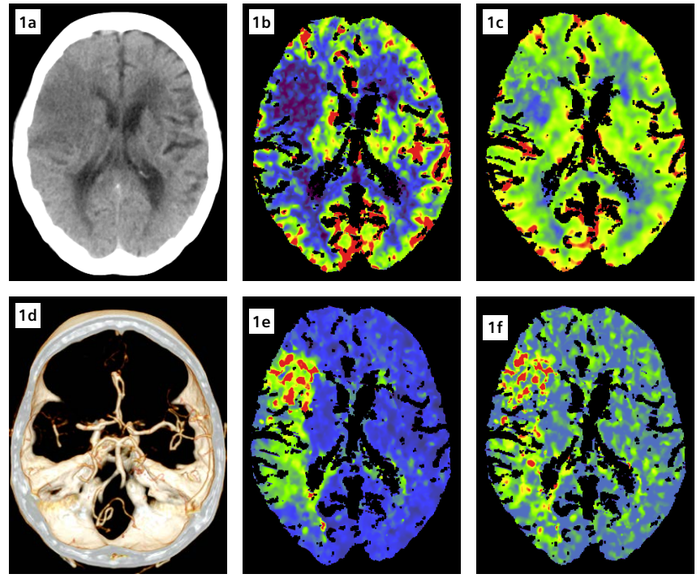
The patient was treated by intravenous thrombolysis. A follow-up Perfusion CT, performed 8 days later, showed a recanalized RMCA and significantly restored perfusion in the corresponding territory.

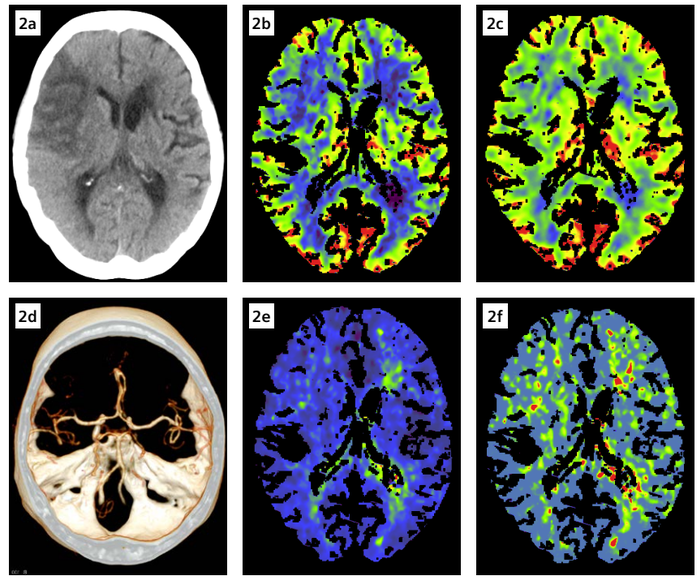
The patient recovered with left-sided weakened muscle strength of 5-, at discharge.

Comments

Acute ischemic stroke is a leading cause of adult disability worldwide. A non-contrast CT is usually performed to exclude intracranial hemorrhage and to check for early signs of ischemia. This is however not sensitive enough for the detection of still viable tissue at risk. Volume Perfusion CT, using the Adaptive 4D spiral mode after a single bolus of contrast, is performed to acquire images tracking the temporal course of iodinated contrast material passing through the cerebral circulation. Perfusion parameters, such as cerebral blood flow (CBF), cerebral blood volume (CBV), mean transit time (MTT), etc. are calculated from the voxel time-attenuation curves. The results may help physicians identify and differentiate still salvageable tissue at risk from tissue that is already infarcted and at risk of hemorrhage with reperfusion. This is important for the patient's treatment planning and follow-up. In this case, despite the fact that the hypodense area shown on the non-contrast CT was relatively large and the time since symptom onset was already 5 hours, intravenous thrombolysis treatment was performed, since the CT perfusion images showed a small core and a large penumbra. Follow-up imaging and the clinical course both indicate that this diagnosis was correct, and that the patient benefited from the treatment. ●



1 **Non-contrast CT image (Fig. 1a) shows a slight hypodense area in the territory of the RMCA, with disappearance of the local sulci and the lateral sulcus, suggesting an ischemic stroke. CBF (Fig. 1b) and CBV (Fig. 1c) images show a mismatch suggesting an existence of a penumbra. TTD (Fig. 1e) and MTT (Fig. 1f) are increased indicating a delayed blood supply. CTA image (Fig. 1d) shows an occlusion of the RMCA.**



2 **A follow-up Perfusion CT (8 days) shows a recanalized RMCA and significantly restored perfusion in the corresponding territory.**