

Perfusion Weighted MRI is Valuable in Identifying Persisting Vessel Occlusion in Acute Posterior Inferior Cerebellar Artery (PICA) Ischemia

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Introduction: In acute stroke of the internal carotid artery territory, the pathology can be further characterized by demonstration of vessel obstruction on MR angiography (MRA) and the extent of hypoperfusion on perfusion-weighted MRI (PWI) [1-3]. Stroke in the posterior circulation occurs only in about 20% of ischemic infarctions [4] and iv thrombolysis as an acute intervention is usually considered for anterior circulation stroke. For this reason most acute MRI studies have focused on anterior circulation stroke. There is usually some redundancy in the MRI results, in that vessel obstruction of the MCA (up to M3 segments) is demonstrated on MRA and a matching area demonstrating a perfusion deficit is identified on PWI. The ability of both MRA and extra- and transcranial color-coded duplex sonography (ECD/TCCD) to demonstrate posterior circulation branches of the vertebral and basilar artery is limited [1, 5, 6]. This study analyzes the value of combined diffusion-weighted MRI (DWI), PWI and MRA in acute stroke in the territory of the posterior inferior cerebellar artery (PICA) in comparison with ECD/TCCD findings.

Material and Methods: We analyzed 16 patients with acute PICA territory ischemia (4 women, 12 men, mean age 61,1 years) who received a MRI stroke workup (3-48 hours after symptom onset) including DWI, PWI and MRA and ECD/TCCD. MRI was performed on 1,5-T MR systems (Magnetom Sonata, Siemens Medical Systems). A standardized protocol was used in all patients: (1) transverse, coronal and sagittal localizing sequences followed by transverse oblique contiguous images (slice thickness 5 mm, field of view 240mm²) aligned with the inferior borders of the corpus callosum; (2) T2-weighted images (turbo spin echo, repetition time [TR] 2620 ms/echo time [TE] 85 ms, 192x256 matrix); (3) T1-weighted images (TR 530 ms/TE 12 ms, 192x256 matrix); (4) DW echo planar [EP] images (TR 4000ms/TE 100 ms, b 0/1000 s/mm², 96x128 matrix, sequential application of 3 separate diffusion-sensitizing gradients in perpendicular directions); (5) perfusion weighted free induction decay-EP sequence following the first pass of contrast bolus through the brain (2000/65/flip angle 90°, 11 slices, 40 acquisitions, 2-second interval, 128x128 matrix); (6) 3-dimensional time-of-flight MRA sequences of the circle of Willis and the neck arteries (flip angle 20°, 165x512 matrix, slice thickness 2 mm). ECD/TCCD focusing on the arteries of the posterior circulation was performed on a Philips HDI 5000 with a 4-7 MHz linear and a 2 MHz sector transducer (frequency-based color mode). MRI and Doppler studies were analyzed independently in a structured format for pathologic characteristics, and compared thereafter concerning the congruence of PWI and ultrasound.

Results: All patients showed DWI lesions in the PICA territory. PWI was sensitive to PICA hypoperfusion, which was demonstrated in 9/16. Four patterns of abnormalities were noted:

- (1) Hypoperfusion on PWI and pathologic MRA and/or ECD/TCCD were seen in (8/16). Six of these patients showed a lack of flow signal of vertebral artery (VA) and/or of PICA on MRA. On ECD/TCCD 4 patients had a pathologic flow signal in the VA.
- (2) 4/16 patients showed normal appearing perfusion but had indications of vessel pathology on MRA and/or ECD/TCCD.
- (3) Despite lack of abnormality on MRA and normal extracranial duplex sonography a perfusion deficit was detected in the PICA territory (figure).
- (4) Patients, who showed normal results on all examinations (3/16).

Matching results for PWI and MRA and/or ECD/TCCD were found in only 11/16 patients (pattern 1 and 4). In total in 5/16 patients the results were not matching and PWI was valuable as it either demonstrated lack of hypoperfusion despite indications of arterial obstruction (pattern 2) or demonstrated hypoperfusion indicating persistent vessel pathology, which could not be detected by means of MRA or ECD/TCCD (pattern 3).

Discussion and Conclusion: The diagnosis of persistent vessel pathology in patients with acute PICA territory ischemia remains difficult, even with combined application of advanced imaging techniques. In particular, direct assessment of the PICA is often not possible with MRA or TCCD.

This study shows how valuable MRI is in this situation if also PWI is employed. PWI in combination with DWI is very helpful since it allows identification of the extent and severity of a perfusion deficit and of tissue areas that may be at risk for infarction or may confirm that no perfusion deficit is present.

References:

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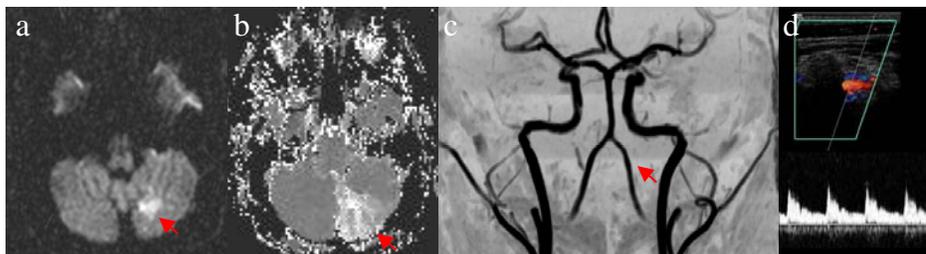


Figure:

MRA/ECD are normal but PICA perfusion deficit on PWI.

DWI performed 5 hours after symptom onset (a) shows an acute ischemic lesion in the left cerebellar hemisphere (arrow), while PWI (b) demonstrates hypoperfusion in the PICA territory (arrow). At the assumed site of PICA origin (arrow), flow signal is absent on MRA (c). Doppler signal of the left VA on ECD is normal (d).