Arterial Spin Label Imaging of Transient Ischemic Attack

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Introduction: Transient ischemic attack (TIA) can often herald a subsequent stroke, with roughly 10% of patients suffering completed stroke within the first 90 days [1]. These patients present emergency room doctors and stroke neurologists with a dilemma; without clinical symptoms, how can one be sure the patient really had a TIA? Since a true TIA is a vascular event, we hypothesize that detecting the "footprints" of this hemodynamic disturbance directly with perfusion imaging will improve a clinician's confidence in the diagnosis. Arterial spin labeling (ASL) is a non-contrast method of measuring brain perfusion that is quite sensitive to mild hemodynamic alterations, particularly the visualization of perfusion alterations in vascular watershed regions, a finding termed the borderzone sign [2]. To that end, we have prospectively evaluated how often ASL imaging abnormalities are present in acute hemispheric TIA patients.

Methods: 24 TIA patients were imaged at 1.5 T within 48 hrs of the resolution of symptoms. In each patient, the symptomatic hemisphere was determined by a stroke neurologist. Pulsed continuous ASL [3] was performed using a background-suppressed 3D FSE readout with the following parameters: TR/TE 4500/5 ms; FOV 22 cm; 6 mm slice thickness, 3.4 mm in-plane resolution; Label time/post-label delay: 1500/2000 ms; imaging time 6 min. 17 of these patients (70%) also received bolus gradient-echo EPI perfusion-weighted imaging (PWI) with the following parameters: TR/TE: 1800-2000/40-60 ms; 128x128 matrix; 7.5 mm slice thickness. Post-processing was performed with RAPID software with automated AIF selection and circular SVD [4]. A neuroradiologist evaluated the ASL and PWI images to determine the presence of a focal abnormality in each hemisphere on DWI, PWI Tmax images (when available), and ASL. If the ASL borderzone sign was present, it was classified as either unilateral or bilateral.

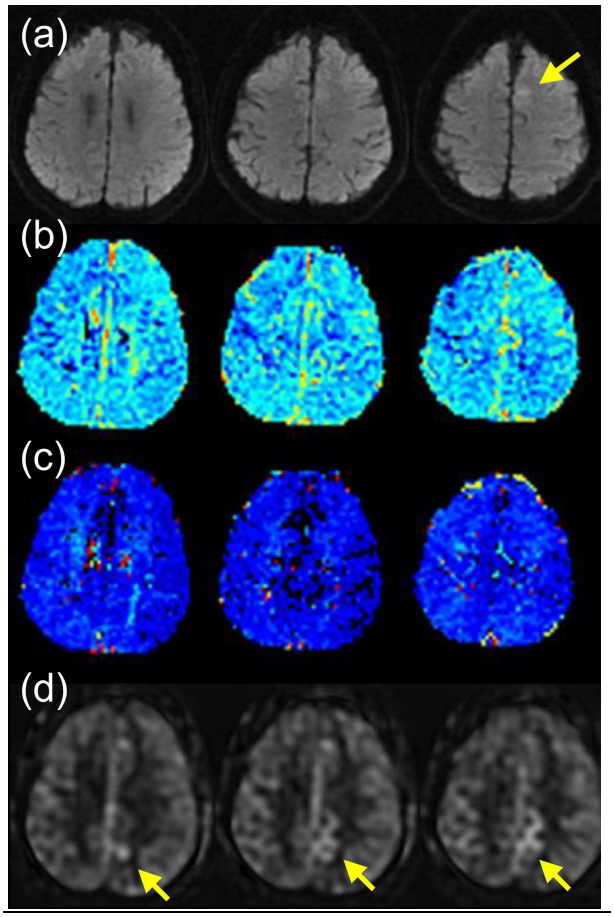

Fig 1: 71 year-old woman with transient right leg weakness (ABCD² score 4). (a) DWI shows a subtle lesion in the left ACA territory. (b) MTT and (c) Tmax maps are normal. (d) ASL demonstrates serpiginous high signal near the diffusion abnormality (arrows), likely representing delayed arterial arrival time. ASL may increase the yield of identifying vascular disturbances in patients with TIA.

Results and Discussion: Seven of 24 patients (29%) had small DWI lesions, consistent with prior TIA studies [5]. Focal ASL abnormalities consisting of arterial transit artifact and/or hypoperfusion were identified in 13/24 patients (54%). ASL was abnormal in 83% of the DWI positive patients, suggesting that the lesions detected are significant. However, in 41% of patients without DWI lesion, ASL still documented evidence of a vascular etiology. In the cases with positive ASL findings, 54% (7/13 patients) demonstrated a borderzone sign, which was unilateral in 3 cases, corresponding in all cases to the hemisphere responsible for the TIA. In patients who also received bolus PWI, 5/17 (29%) demonstrated abnormalities on Tmax, similar to a previous report [6]. No patients were identified who had a bolus PWI Tmax lesion and a normal ASL study, suggesting that ASL has higher sensitivity for minor perfusion abnormalities. In the 12 patients with normal DWI and bolus PWI, 3 patients (25%) were identified in which an ASL abnormality was the only evidence of a recent vascular event. An example of a TIA patient in which ASL demonstrates a vascular cause is shown as **Fig 1**.

Conclusions: ASL may be a useful addition to the workup of TIA patients, as it appears to be highly sensitive to detect a subtle perfusion abnormality and thus provide objective evidence of recent vascular event.

References: 1. Giles et al., Lancet Neurol 2007;6:1063; 2. Zaharchuk et al., Radiology 2009;252:797; 3. Dai et al., MRM 2009;60:1488; 4. Straka et al., ISMRM 2009; 1466; 5. Ay et al., Stroke 2009;40:181; 6. Mlynash et al., Neurology 2009;72:1127.

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