

# Arterial Spin-Labeled Magnetic Resonance Imaging in Hyperperfused Seizure Focus: A Case Report

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**Abstract:** We present a case of a clinically suspected cerebral infarction that was diagnosed as a seizure focus on pulsed arterial spin labeling. The finding of hyperperfusion with perfusion imaging significantly impacted clinical management of the patient.

**Key Words:** pulsed arterial spin labeling, PASL, ASL, hyperperfusion, seizure

(*J Comput Assist Tomogr* 2008;32:291–292)

Spin tag perfusion imaging is a predominantly research magnetic resonance imaging (MRI) sequence for measuring quantitative cerebral blood flow. It has numerous advantages over conventional perfusion imaging techniques, including repeatability, absolute quantification, and the lack of a need for intravenous contrast administration. Here, we present an unusual case of hyperperfusion in the setting of postictal seizure in which spin tag perfusion imaging played a key role for proper diagnosis.

## CASE REPORT

A 38-year-old man with no significant medical history presented to the emergency department with a 2-day history of sinus drainage, bifrontal headaches, and dizziness. He was diagnosed with diabetes. One day after discharge, his fiancée witnessed him having a generalized tonic-clonic seizure. The patient was started on Dilantin therapy but was found to be neglecting the right side of his body. He was subsequently transferred to our institution for a stroke evaluation. Examination of the visual fields demonstrated a right homonymous hemianopsia, intact extraocular muscles, and decreased visual acuity on the left.

The clinical service was concerned regarding a cerebral infarction, encephalitis, or an underlying mass lesion. Cerebrospinal fluid analysis was negative. Magnetic resonance imaging of the brain was performed using conventional sequences and multislice pulsed arterial spin labeling (PASL). Initially, the conventional imaging was thought to be negative for infarction, infection, and possible seizure etiologies (Figs. 1A, B). Analysis of the PASL images showed marked focal hyperperfusion involving the left posterior cerebral artery distribution (Fig. 2). This refocused the conventional MRI examination

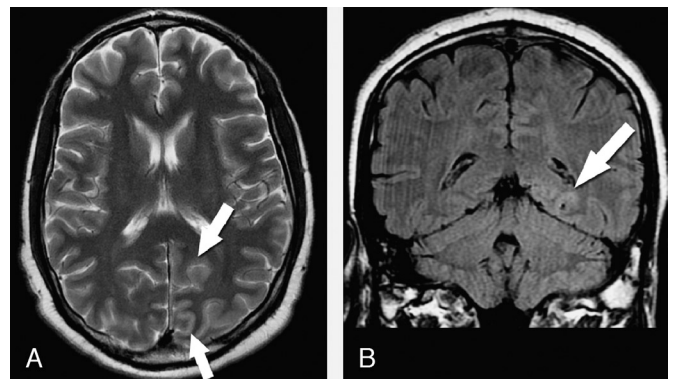
in which very subtle signal abnormalities were seen on the fluid-attenuated inversion recovery and T2-weighted sequences in the left posterior cerebral artery distribution. Findings from the diffusion and postcontrast images were normal. Discussion with the clinical service revealed that the patient had a witnessed seizure 1 hour before the MRI examination. Hyperperfusion on PASL with the otherwise negative findings on conventional MRI ended the stroke evaluation and allowed the clinical team to refocus on the seizure evaluation.

The patient was discharged home on seizure prophylaxis with standard seizure precautions. His seizure etiology was ascribed to the initiation of oral glycemic medications and a rapid change in his blood glucose level. At 1-month follow-up, the patient remained seizure-free, and all symptoms had completely resolved with full restoration of his visual fields.

## DISCUSSION

Arterial spin-labeled perfusion MRI was first described over a decade ago<sup>1,2</sup> and has been an active area of research.<sup>3–5</sup> The main advantages of arterial spin label over conventional bolus tracking for perfusion measurement are that it is completely noninvasive (requires no gadolinium-based contrast to be injected), can be repeated in the same session, and provides absolute blood flow information (in units of milliliters per 100 g of tissue per minute). This unique ability gives the PASL sequence a significant advantage as compared with traditional perfusion protocols in seizure imaging.

Nuclear medicine positron emission tomography and single photon emission computed tomography have traditionally been used to evaluate the patient in the interictal and ictal state. Regions of hyperperfusion during the ictal state and hypometabolism in the



**FIGURE 1.** A, Axial T2-weighted image through the lateral ventricles shows subtle increased signal within the cortex of the left occipital lobe (arrows). B, Fluid-attenuated inversion recovery sequence shows minimally increased signal in the inferior cortex of the left occipital lobe (arrow).

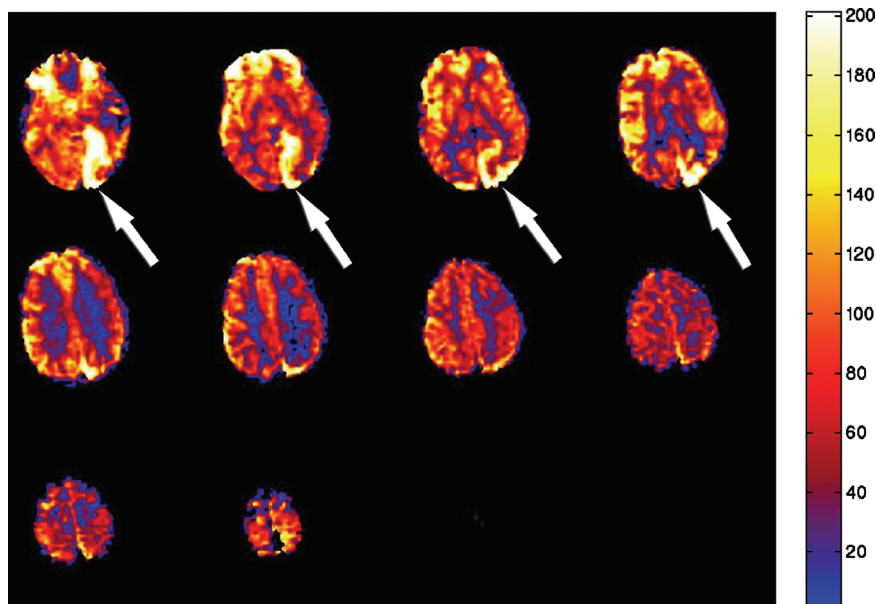
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Received for publication June 21, 2007; accepted June 22, 2007.

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There are no conflicts of interest, and no financial support has been provided. This case has not been otherwise published.

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**FIGURE 2.** Quantitative cerebral blood flow map (milliliters per 100 g of tissue per minute) generated from the PASL sequence shows significant hyperperfusion (white arrows) within the cortex of the left occipital lobe corresponding to the subtle signal abnormalities on the conventional MRI sequences.

postictal state can be assessed based on radiotracer activity. Single photon emission computed tomography hyperperfusion has also been shown 6 hours after the seizure.<sup>6</sup> These types of studies require separate evaluations over multiple days and require radiopharmaceuticals that must be prepared in advance.<sup>7,8</sup>

The PASL sequences have been studied regarding ischemic hypoperfusion and blood flow quantification of brain tumors, but very little research exists on regional hyperperfused states.<sup>9–13</sup> The patient presented here vividly demonstrates the capability of the PASL sequence to demonstrate regions of hyperperfusion in the postictal state. Ordinarily, one would expect hyperperfusion to be seen only if the PASL sequence was performed during a seizure. However, hyperperfusion has been shown to occur in the postictal state in the parahippocampal gyri using T2-weighted gadolinium bolus perfusion. This finding has been attributed to increased metabolism attempting to restore the interictal state of neuronal excitability.<sup>14</sup>

Studies have been performed using computed tomography perfusion to show increased regional blood flow during subtle status epilepticus, but the necessity of intravenous contrast limits repeatability.<sup>15</sup> The ability to repeat the PASL sequence makes it readily amenable to implementation in the evaluation of a seizure focus. For example, using this technique, it is possible to initiate a protocol of a baseline PASL study with subsequent postictal PASL imaging to identify the region of hyperperfusion or hypoperfusion corresponding to the seizure focus. Larger studies with nuclear medicine and surgical outcome correlation would be needed to show the efficacy of the PASL sequence in seizure imaging.<sup>16</sup>

## CONCLUSIONS

Hyperperfusion in the postictal state has been described, but until now, a safe, nonradioactive, noncontrast, easily repeatable imaging study has not been available. As PASL becomes more widely implemented in the clinical realm, its unique advantages over conventional perfusion studies give this MRI sequence significant potential in the evaluation of the seizure patient.

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