Applications of Arterial Spin Labeling (ASL) Perfusion MRI in Clinical Pediatric Neuroimaging

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Purpose

Arterial spin labeling (ASL) perfusion has become more accesible for routine clinical MRI use in the last few years. Both commercial and noncommercial ASL sequences are now more available on clinical MRI scanners, some with in-line automated postprocessing, but there is a relative paucity of literature on their clinical use in children. The purpose of this educational exhibit is to demonstrate the clinical utility and various neuroradiological applications of arterial spin labeling perfusion MR imaging in the pediatric population by presentation and discussion of representative clinical cases. The advantages, clinical challenges, and limitations of using ASL perfusion in routine pediatric neuroimaging will also be discussed.

Outline of Content

A very brief overview of of the principles of arterial spin labeling perfusion MRI will be given. The potential advantages of using ASL perfusion imaging and its variants in pediatric neuroimaging will be presented.

An example of an ASL imaging protocol for use in children that has been utilized for imaging thousands of children in our institution will be provided. The clinical utility of ASL methodology will be demonstrated and discussed for a number of neuroimaging applications in the pediatric population. These clinical applications include various disorders such as arterial ischemic stroke, hypoxic-ischemic injury, migraine (Figure 1), moyamoya disease (Figure 2), vascular malformations, congenital heart disease, and post-radiation therapy changes. Use of ASL perfusion MRI in the imaging evaluation and follow-up of pediatric brain tumors and masses will also be presented.

The limitations of arterial spin labeling methods and the technical challenges and interpretive nuances in the application of ASL perfusion in imaging evaluation of these different illustrative clinical cases will also be discussed.
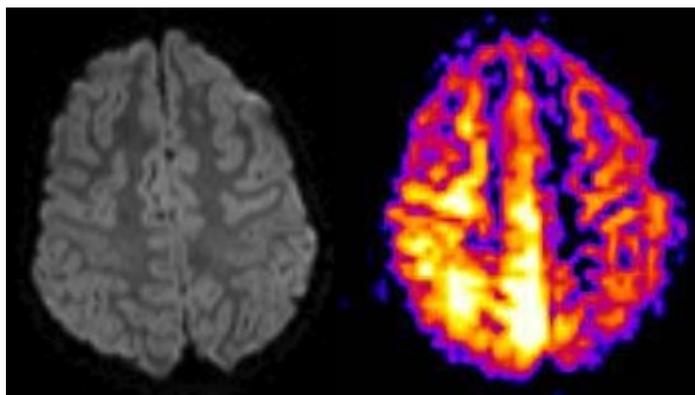

Figure 1. A child presenting with headache and acute severe left hemiparesis. Diffusion images show no abnormality. ASL images show abnormally increased blood flow (hyperperfusion) in the right cerebral hemisphere, corresponding to the side of acute neurological deficit. Final diagnosis was hemiplegic migraine.
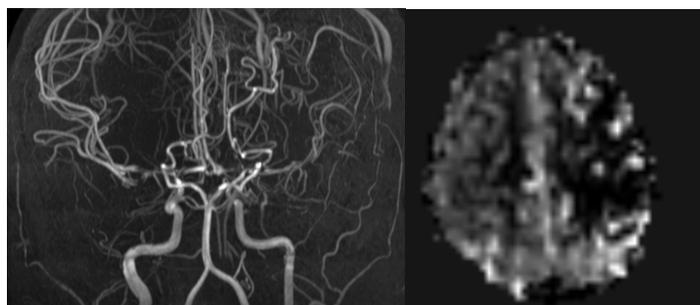

Figure 2. A young child with moyamoya, showing markedly narrowed vessels on head MRA, predominantly on the left side. Corresponding ASL perfusion images show low parenchymal signal in the left middle cerebral artery distribution and high signal in the left sided MCA branches.

Summary

Arterial spin labeling perfusion has great potential in pediatric neuroimaging. The use of this technique in evaluation of the pediatric brain is likely to increase in the coming years. The clinical utility, advantages and limitations of these techniques in the pediatric population should be recognized for optimal use and image interpretation in various neurological disorders of children.