ASL perfusion MRI in hypothermia treated infants with hypoxic ischemic encephalopathy

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Target audience: Pediatric neuroradiologists, neonatologists.

Purpose: To assess global and regional perfusion changes on ASL after therapeutic hypothermia in patients with hypoxic ischemic encephalopathy (HIE) and compare ASL changes to conventional MRI findings. Knowledge of ASL changes after hypothermia may guide treatment and help predict outcome in future prospective longitudinal studies.

Methods: MR images including axial pseudocontinuous 3D ASL(arterial spin labeling) obtained on a 3T scanner of eight term neonates meeting the criteria for therapeutic hypothermia between October 2012 and October 2013 were included in this retrospective observational study. The mean age of the subjects at the time of MR imaging was 8 days.CBF maps were generated with the use of Functool software. After co-registering corresponding T2 images to the CBF maps, basal ganglia and thalamic CBF were calculated. Global and deep gray matter perfusion values were compared to the ranges reported in the literature for normal (global CBF10-20mL/100gr per minute, basal ganglia 31±5mL/100gr per minute, thalamus 29±6 mL/100gr per minute) neonates[1] and qualitative MRI findings.

Results: On conventional MR images 2 subjects had hemispheric injury, 1 had deep gray matter injury and 2 had mixed injury. 3 patients did not have any evidence of restricted diffusion or abnormal T1 hyperintensity. The mean global, basal ganglia and thalamic CBF were 20±1.4, 45.1±12.8 and 40.5±8.2 mL/100gr per minute respectively. 2 subjects with basal ganglia injury had hypoperfusion in the basal ganglia compared to normals in the second week of life. There was one patient with severe diffuse cerebral restricted diffusion and basal ganglia injury with hyperperfusion on ASL who was imaged on day four most likely related to timing of imaging. The same subject also had increased global CBF (27.1mL/100gr per minute) compared to reported normal ranges. 4 subjects (2 with hemispheric injury and 2 without evidence of injury on conventional MRI) had increased CBF within the deep gray matter.

Discussion: Neonates with qualitative basal ganglia injury on conventional MR imaging had lower CBF reflecting a decreased metabolic state after progression to irreversible injury. Relative hyperemia compared to reported controls in the basal ganglia and thalami with no corresponding deep gray matter qualitative abnormality may represent variable timing of injury evolution.

Conclusion: Disturbed CBF can be detected and quantified by ASL in hypothermia treated infants with HIE in the second week of life. This study is a validation of the published ASL results in the second week of life after therapeutic hypothermia in our cohort. Further longitudinal studies are needed to evaluate the timing and progression of hyperperfusion after perinatal asphyxia and to determine if prolongation of hypothermia could mitigate this hyperperfusion phase.

[1]Massaro, a N., Bouyssi-Kobar, M., Chang, T., Vezina, L. G., du Plessis, a J., & Limperopoulos, C. (2013). Brain perfusion in encephalopathic newborns after therapeutic hypothermia. *AJNR. American journal of neuroradiology*, *34*, 1649–55.