Arterial spin labelled imaging for cerebral blood flow

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Pseudo-continuous arterial spin labeling (pCASL) measurements were performed in 20 patients with idiopathic normal pressure hydrocephalus (iNPH) to investigate whether cerebral blood flow (CBF) increases during the first 24 hours after a cerebrospinal fluid tap test (CSF TT) in Uppsala University Hospital Sweden.. Five pCASL magnetic resonance imaging (MRI) scans were performed. Two scans were performed before removal of 40 mL CSF, and the other three at 30 minutes, 4 hours, and 24 hours, respectively after the CSF TT. Thirteen different regions of interest (ROIs) were manually drawn on coregistered MR images. In patients with increased CBF in lateral and frontal white matter after the CSF TT, gait function improved more than it did in patients with decreased CBF in these regions. However, in the whole sample, there was no significant increase in CBF after CSF removal compared with baseline investigations. The repeatability of CBF measurements at baseline was high, with intraclass correlation coefficients of 0.60 to 0.90 for different ROIs, but the median regional variability was in the range of 5% to 17%. Our results indicate that CBF in white matter close to the lateral ventricles plays a role in the reversibility of symptoms after CSF removal in patients with iNPH [1)].

Regional cerebral blood flow has previously been studied in patients with idiopathic normal pressure hydrocephalus with imaging methods that require an intravenous contrast agent or expose the patient to ionizing radiation. The purpose of a study of Virhammar et al. was to assess regional CBF in patients with idiopathic normal pressure hydrocephalus compared with healthy controls using the noninvasive quantitative arterial spin-labeling MR imaging technique. A secondary aim was to compare the correlation between symptom severity and CBF.

Differences in regional cerebral perfusion between patients with idiopathic normal pressure hydrocephalus and healthy controls were investigated with pseudocontinuous arterial spin-labeling perfusion MR imaging. Twenty-one consecutive patients with idiopathic normal pressure hydrocephalus and 21 age- and sex-matched randomly selected healthy controls from the population registry were prospectively included. The controls did not differ from patients with respect to selected

vascular risk factors. Twelve different anatomic ROIs were manually drawn on coregistered FLAIR images. The Holm-Bonferroni correction was applied to statistical analyses.

In patients with idiopathic normal pressure hydrocephalus, perfusion was reduced in the periventricular white matter ($P < .001$), lentiform nucleus ($P < .001$), and thalamus ($P < .001$) compared with controls. Cognitive function in patients correlated with CBF in the periventricular white matter ($r = 0.60$, $P < .01$), cerebellum ($r = 0.63$, $P < .01$), and pons ($r = 0.71$, $P < .001$).

Using pseudocontinuous arterial spin-labeling, they could confirm findings of a reduced perfusion in the periventricular white matter, basal ganglia, and thalamus in patients with idiopathic normal pressure hydrocephalus previously observed with other imaging techniques [2].

Perfusion magnetic resonance image with arterial spin labeling (ASL) provides a completely noninvasive measurement of cerebral blood flow (CBF). However, arterial transient times can have a marked effect on the ASL signal. For example, a single postlabeling delay (PLD) of 1.5 seconds underestimates the slowly streaming collateral pathways that maintain the cerebrovascular reserve (CVR).

Although dual PLD methods may not be a completely alternative test for 123I-iodoamphetamine single-photon emission computed tomography with acetazolamide loading, it is a feasible, simple, noninvasive, and repeatable technique for assessing CVR, even when employed in a routine clinical setting [3].

Arterial spin labeling (ASL)-MRI is becoming a routinely used sequence for ischemic strokes, as it quantifies cerebral blood flow (CBF) without the need for contrast injection.

Allows the weighting of the MRI signal by cerebral blood flow.

ASL-MRI revealed nidus location in cerebral arteriovenous malformation and patency after treatment thanks to its ability to demonstrate focal increased CBF values. Absolute quantification of CBF values could be relevant in the follow-up of pediatric brain AVM after partial treatment, although this must be confirmed in larger prospective trials [4].

Prior to ASL, the techniques used for determining cerebral blood flow were rather invasive and involved the use of exogenous contrast agents, such as like the 15O H2O radiotracer in Positron Emission Tomography

The principles behind ASL are quite similar to those utilizing exogenous contrast agents. However, ASL is completely non-invasive (no injections) and the tracer used is not radioactively labeled water, but magnetically labeled water.

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3)

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4)

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