Arterial Spin Labeling

How and what

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Introduction

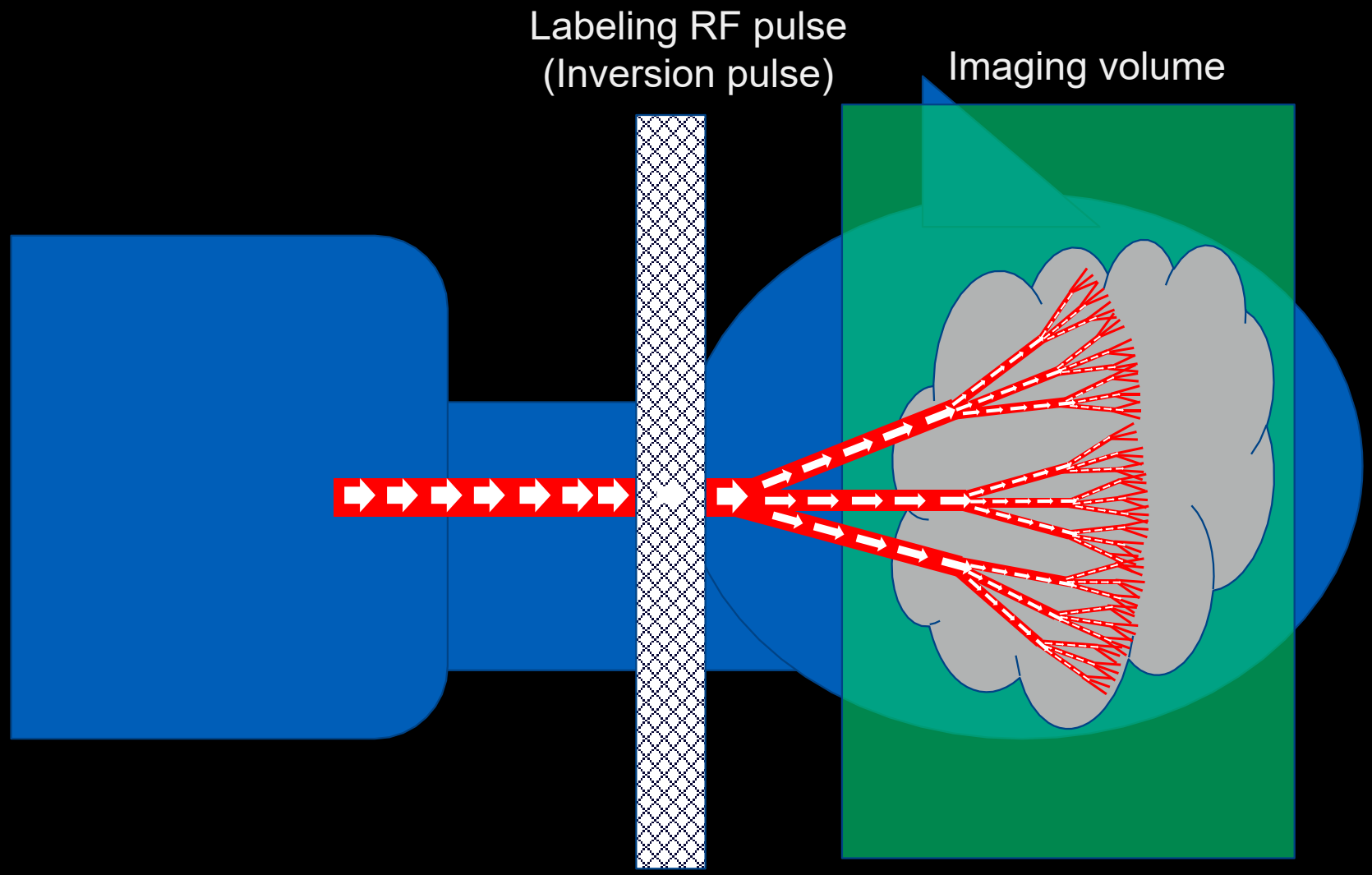
Advantages of using 3D ASL

Without contrast media injection	Scan can be repeated (if motion) and performed on every patient (pediatric, impaired kidney function, etc.) No risk of allergy or damaging fragile vessels
Based on 3D FSE	Free of geometrical/susceptibility distortion (particularly important @3T)
Cerebral Blood Flow (CBF)	Quantitative maps of CBF in [ml/100g/min] True quantification independent of coil, field strength, heart rate, etc.

ASL

The technique

Arterial Spin Labeling

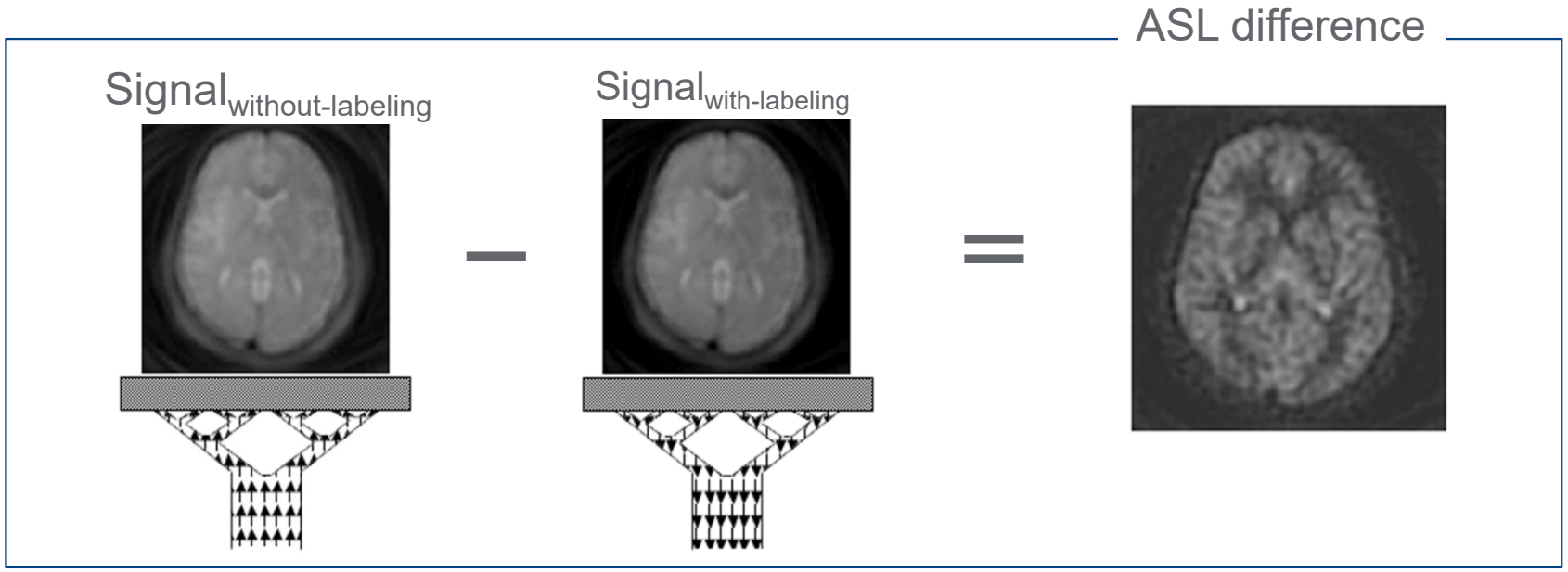


The ASL signal depends on the delay between the labeling pulse and the acquisition of the volume.

This time, called Pulse Labeling Delay (PLD), is chosen according to the velocity of the arterial blood of the patient (1-1.5 seconds).

Arterial Spin Labeling

Cerebral Blood Flow map calculation



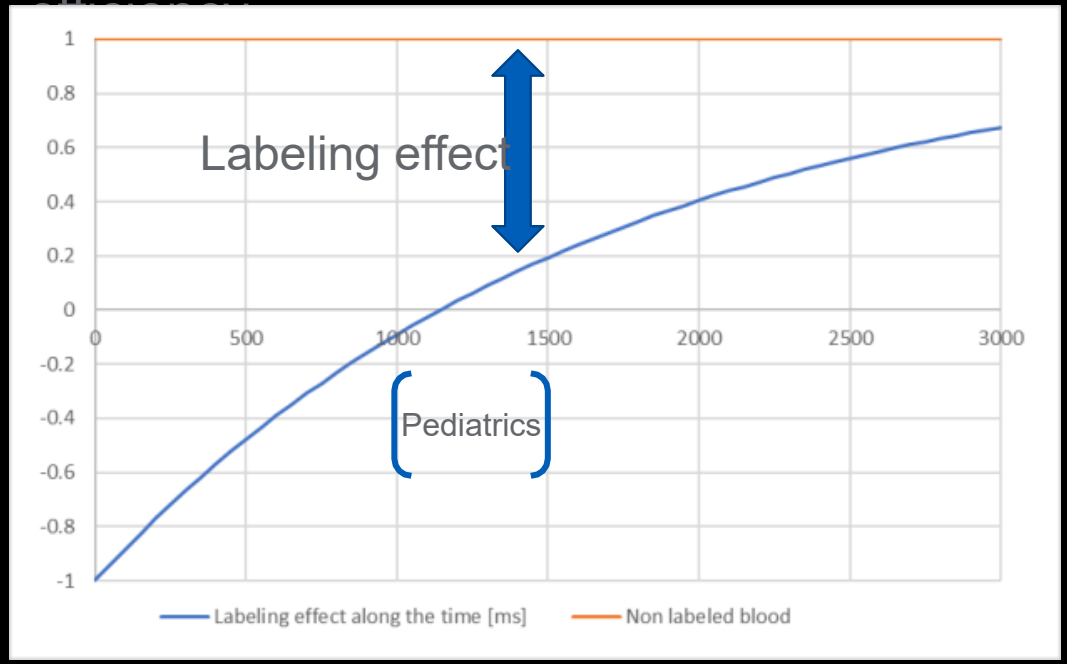
$$CBF\ [ml/100g/min] \propto Signal_{without\text{-}labeling} - Signal_{with\text{-}labeling}$$

Arterial Spin Labeling

Two keypoints to keep in mind:

The inverted blood slightly decreases the signal from the tissue (<1%) of the Imaging volume: several acquisitions are required to improve the SNR.

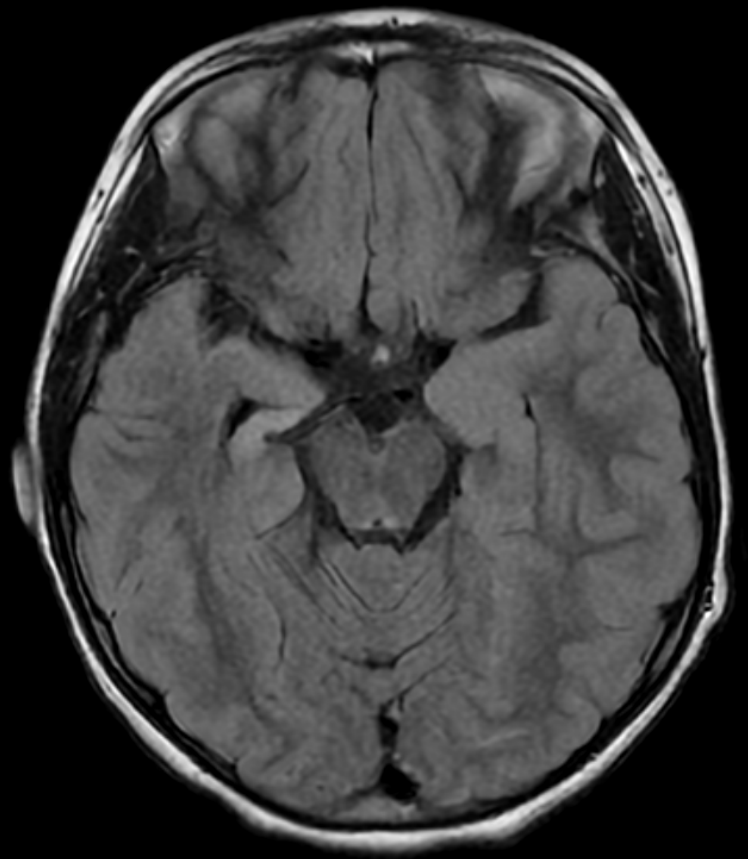
The effect of the labeling pulse on the arterial blood decreases along the time: shorter the PLD, better the labeling



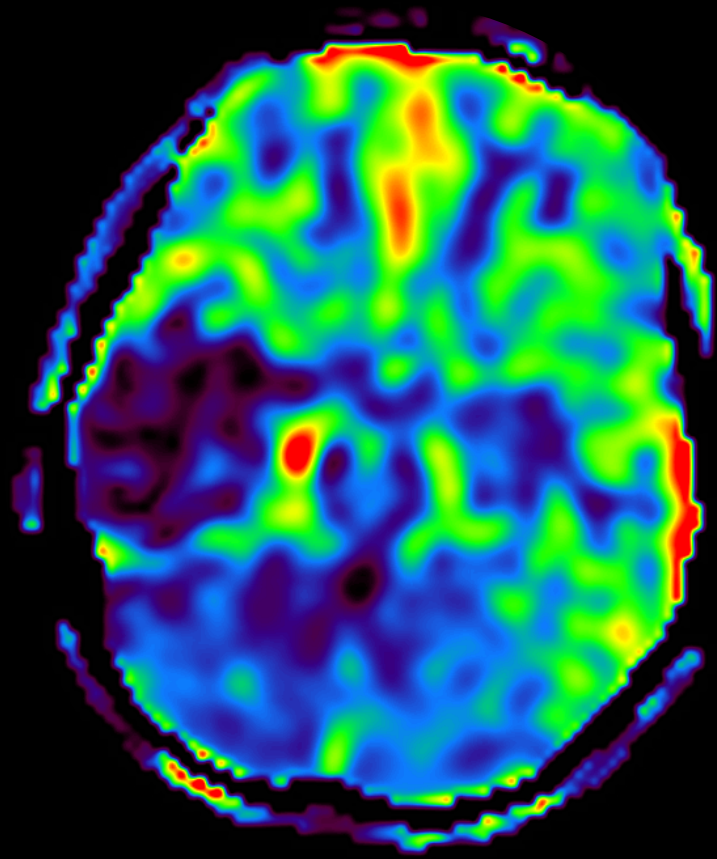
ASL

The typical scopes of interest

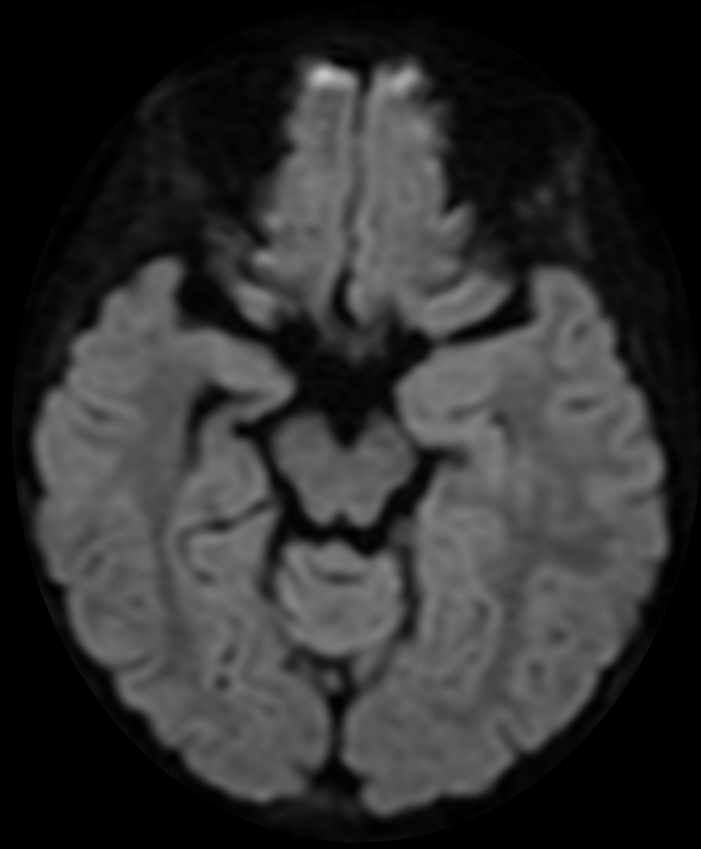
Dysplasia – 9y old



T2 FLAIR 2D

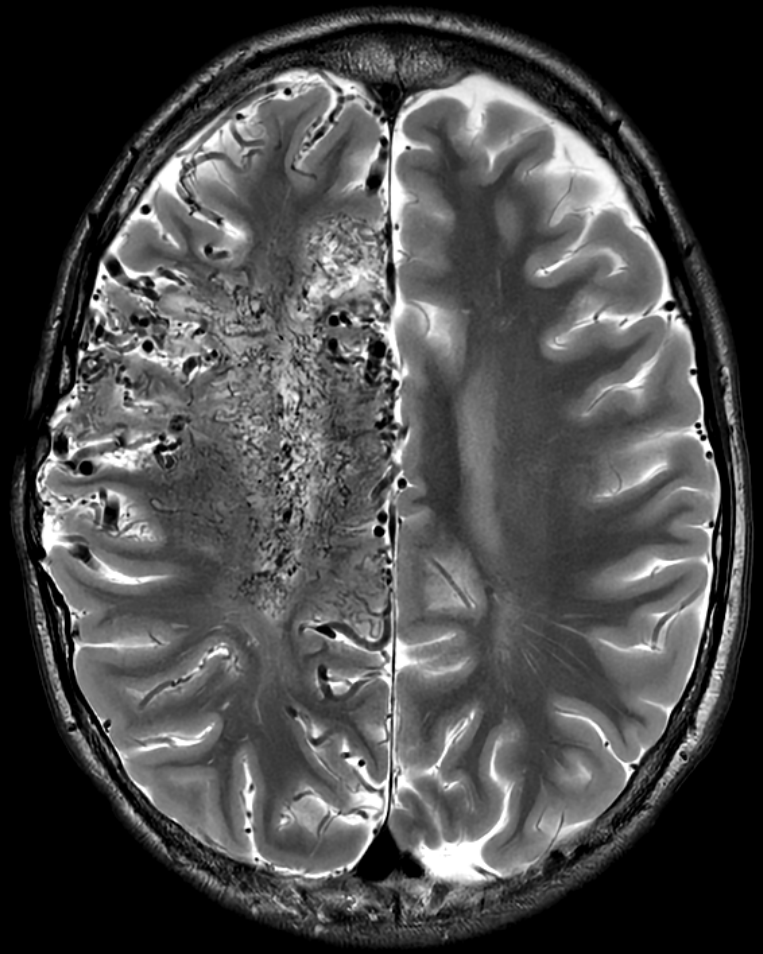


CBF ASL
PLD 1000ms

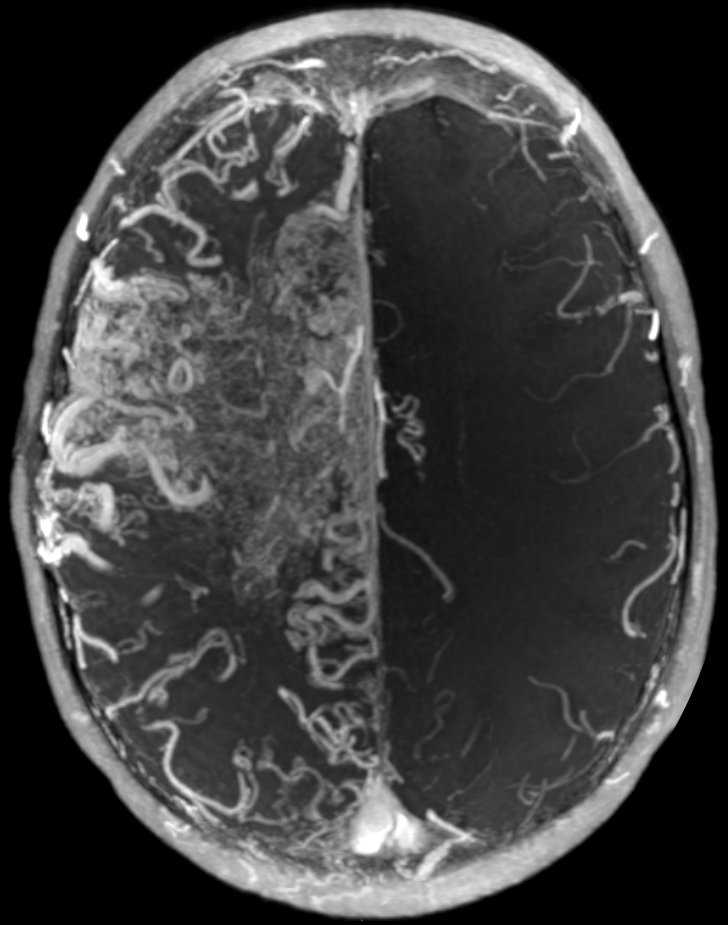


Diffusion
b 1000s/mm^2

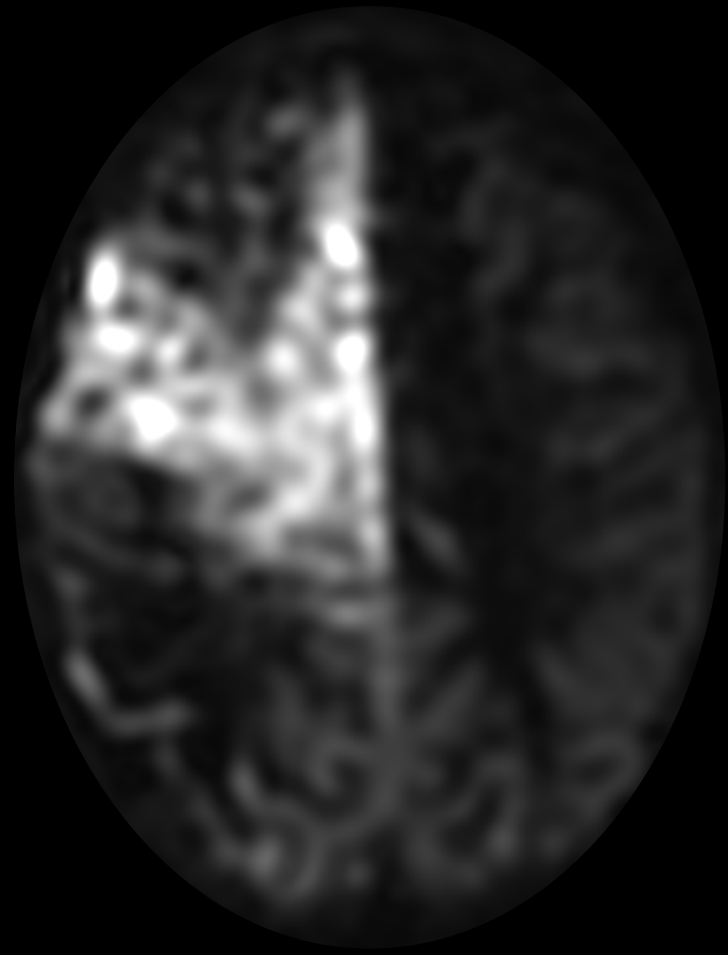
Angiopathy – 12y old



T2 FSE



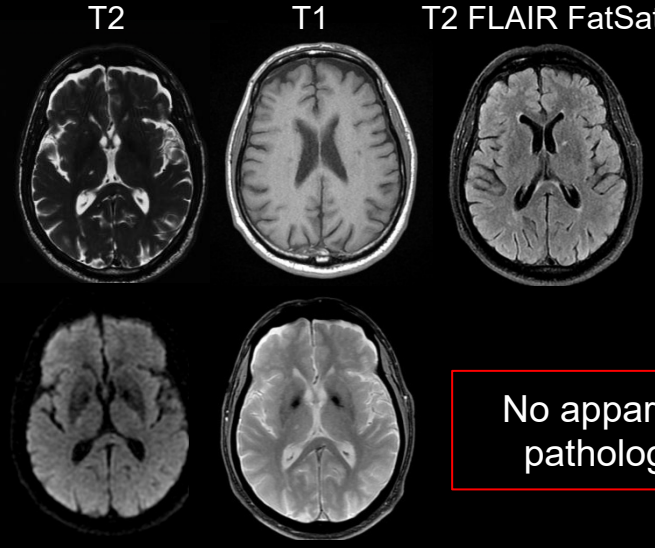
TOF inj



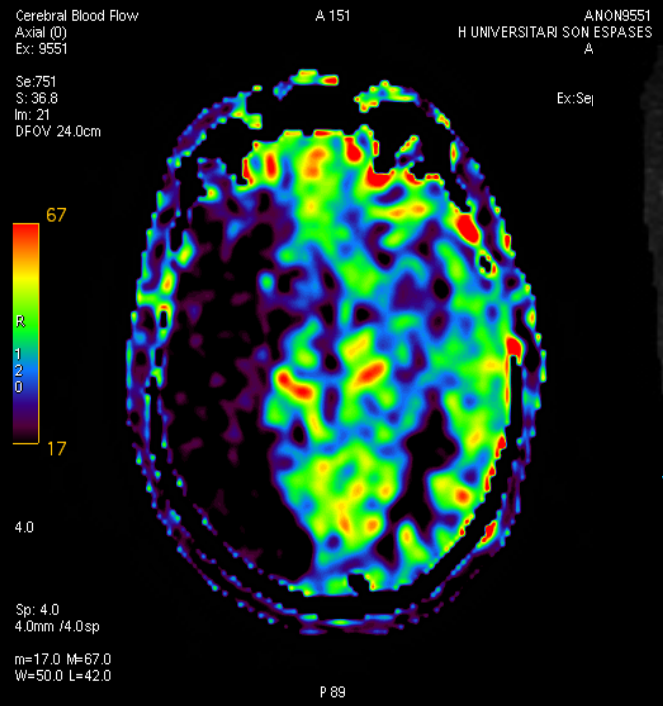
ASL
PLD 1500ms

Patient with carotid occlusion

Male, 69 year old.
Temporary loss of consciousness
Patient sent to MR for routine brain exam



No apparent pathology



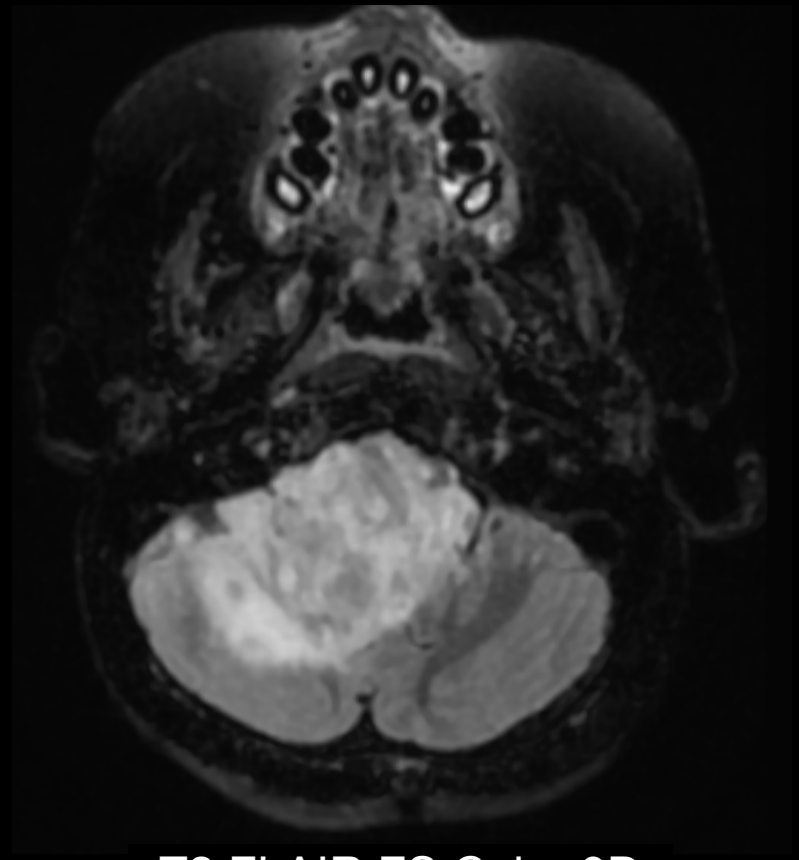
3D ASL

3D Inhance without injection

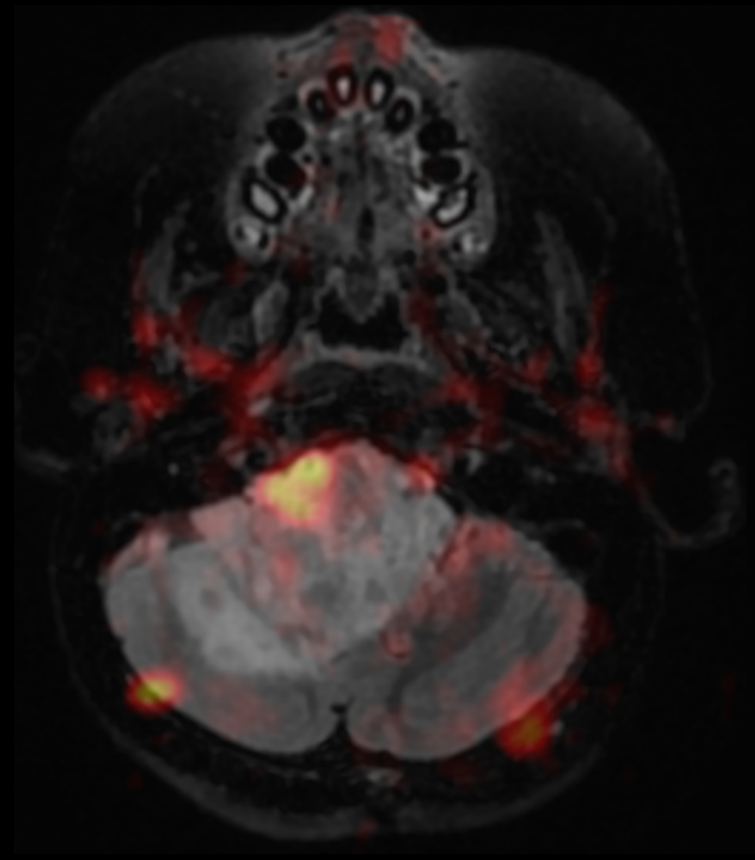
3D CE-MRA

Courtesy HUSE Palma de Mallorca, Spain (MR450w)

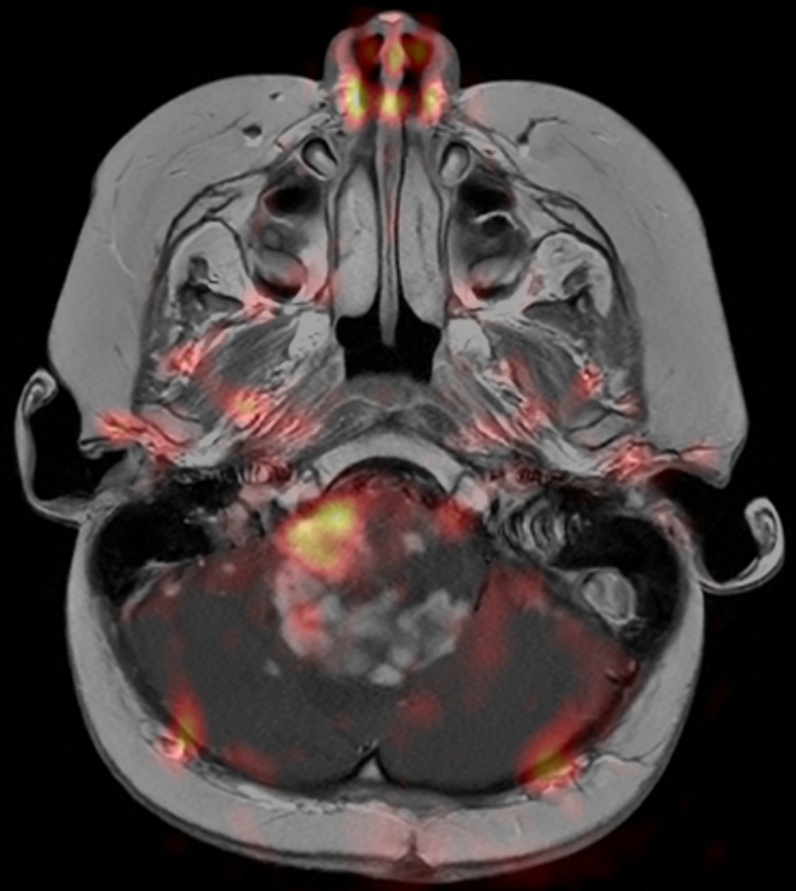
Tumor – 6y old



T2 FLAIR FS Cube 3D

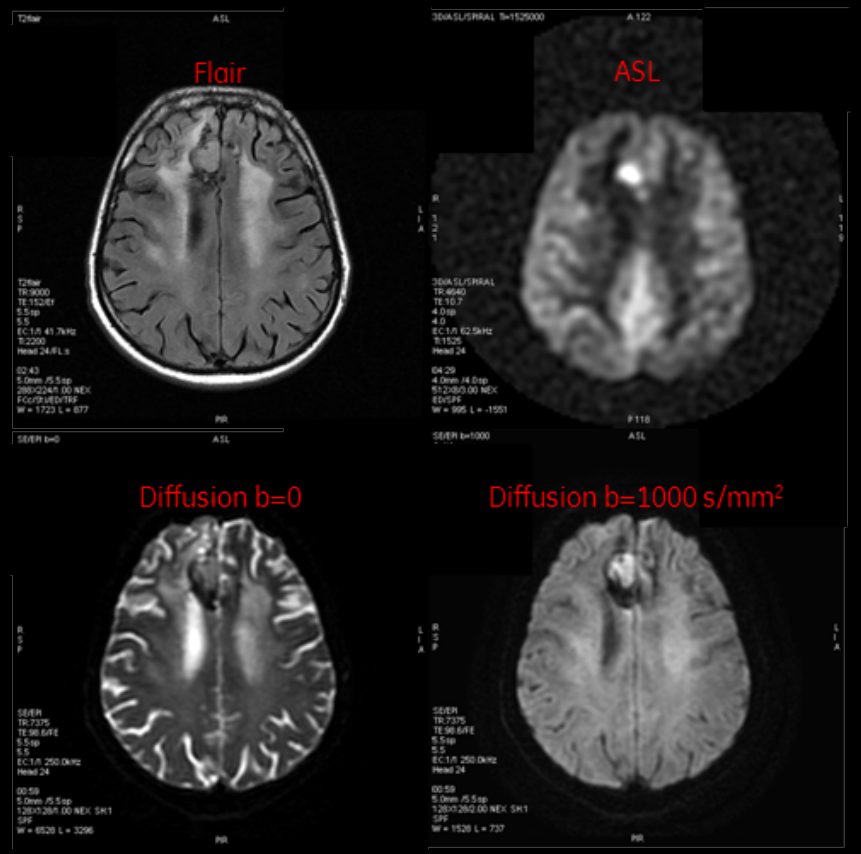


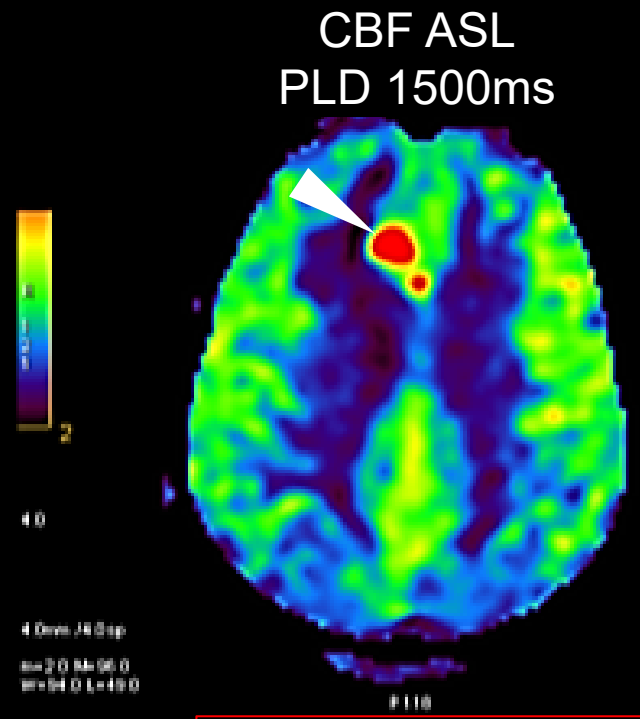
ASL PLD1500ms fused with T2 FLAIR FS Cube 3D

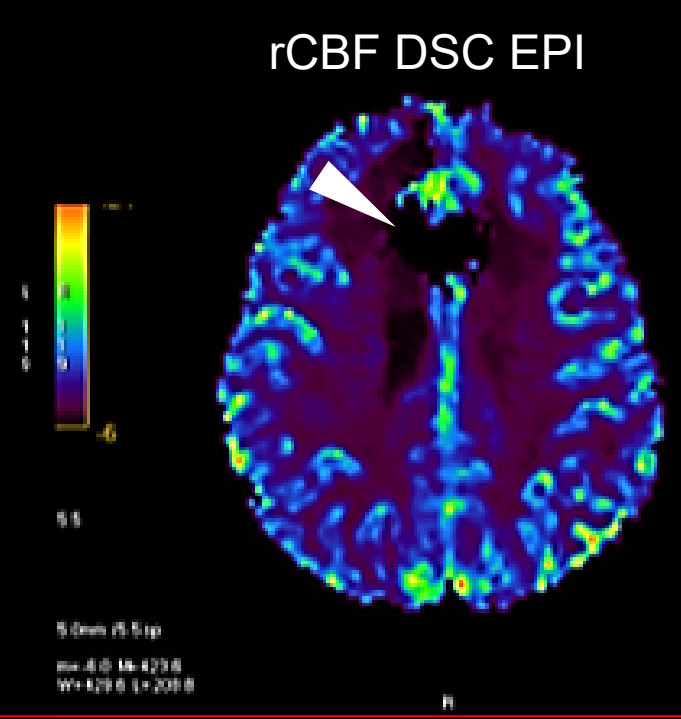


ASL PLD1500ms fused with T1 SE +inj

Tumor with blood product







ASL provides perfusion information even in presence of susceptibility artifacts, while DSC T2* Perfusion is prone to susceptibility artifacts

Courtesy Institut Gustave Roussy, France (MR750w)

Arterial Spin Labeling

To conclude

Pediatrics are the best population to apply the ASL since they have a higher blood flow and the labeling pulse reaches its best efficiency.

ASL is useful to detect any flow difference, inside and outside the imaging volume.

ASL is useful to detect local vascular changes to complete the detection of potential tissular changes.