Magnetization Transfer

Concept

- Think of MT pulses as "macromolecule sat pulses" which selectively suppress tissues with significant water-macromolecule interactions

Mechanism

- ***magnetization transfer (MT)*** is the physical process by which macromolecules and their closely associated water molecules ("bound" pool) cross-relax with free water protons.

- Applying extra radiofrequency (RF), using specially designed off-resonance ***MT pulse,*** *transfer* energy exclusively to the bound pool.

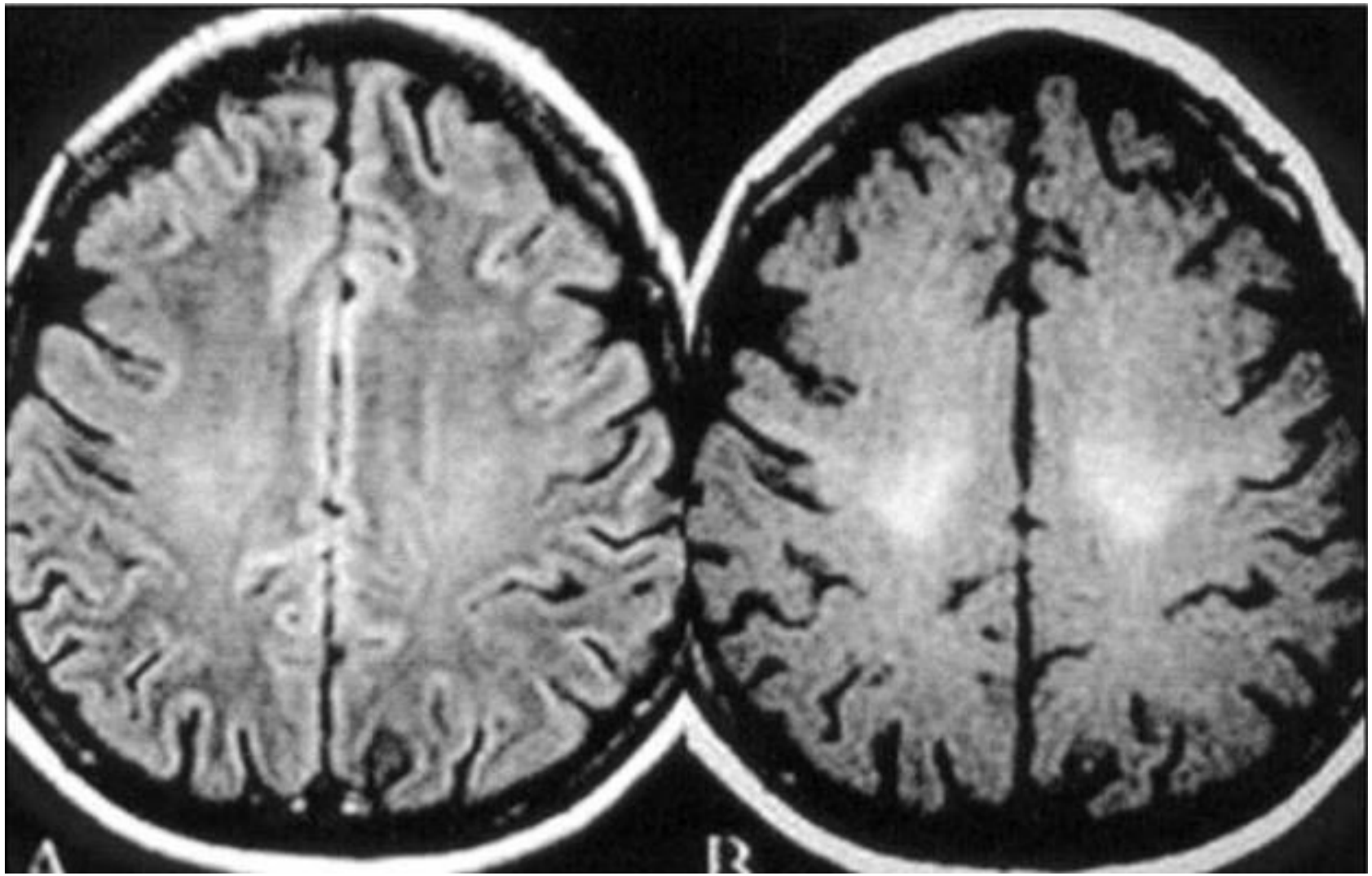
- Some coupling between the free water pools and bound water pool may cause the free water pool partial saturation.

Mechanism

- Therefore, saturated protons from the macromolecule partially transfer their magnetisation to free water protons and some free water protons thus become saturated.

- if another radiofrequency pulse is applied, this time at the Larmor frequency of the free-water protons, the signal from the free water is reduced due to the pre-saturation of some free-water protons.

Application Example



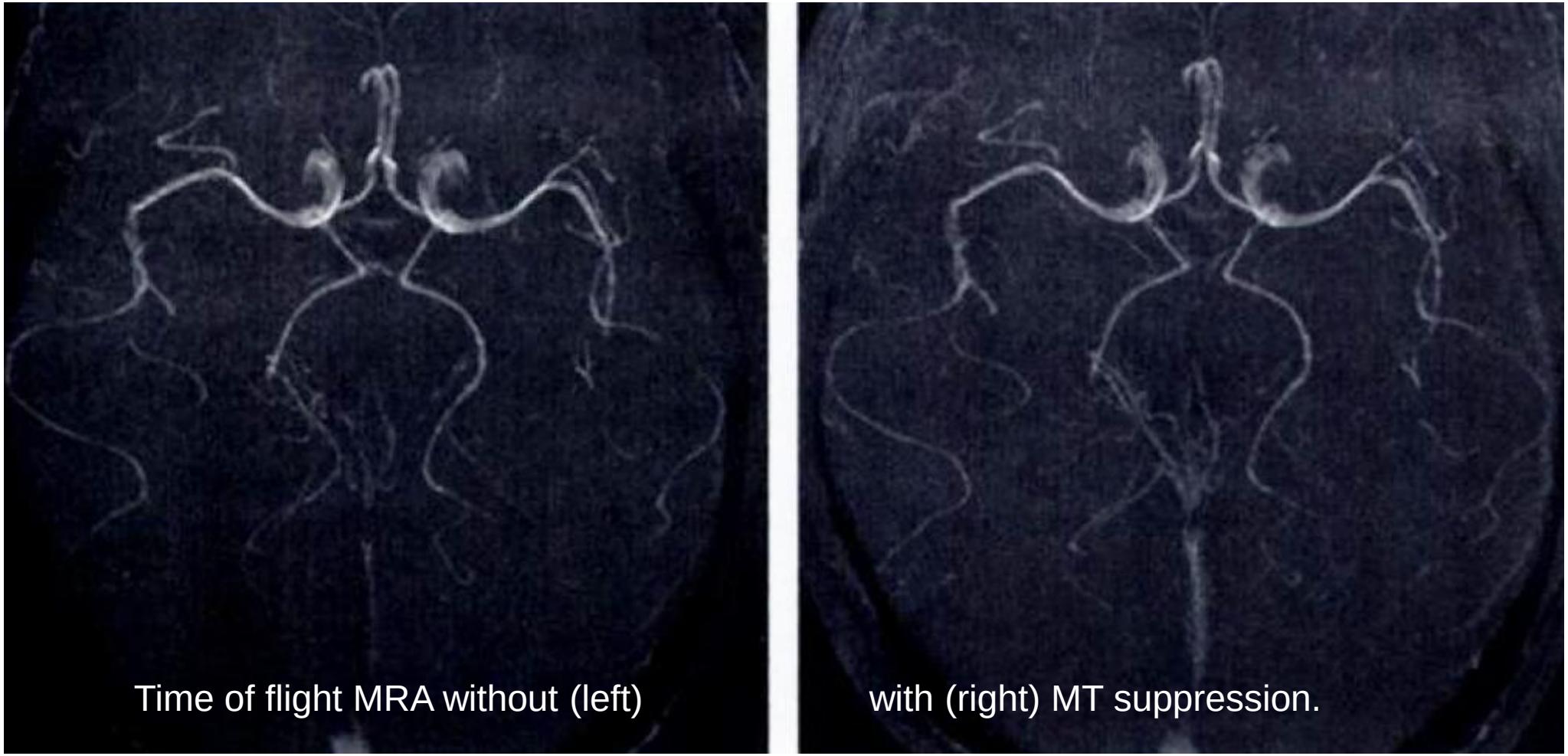
FLAIR

MT to detect ASL

(Amyotrophic Lateral Sclerosis)

Application Example

- The suppression of background tissue by MT makes the technique useful for MR angiography (MRA) to make small vessel more visible.



Time of flight MRA without (left) with (right) MT suppression.

MTR (magnetization transfer ratio)

- measuring the signal intensity with and without application of the pulses and calculating the changes give us MTR

$$MTR = (S_o - S_{MT})/S_o$$

- MTRs can be used to detect changes in the structural status of brain parenchyma that may or may not be visible with standard MR techniques.

- Eg; Subcategorization of multiple sclerosis lesions into those with very low MTR (demyelinated lesions) and slightly decreased MTR (edematous lesions).

- In cases of metastatic disease, MTRs of brain lesions indicate structural changes beyond the extent of the lesions seen on standard MR images. These findings may be due to chronic edema, myelin loss, and perhaps previous undetected tumor.