# **Magnetic resonance**

# Techniques

Magnetic resonance techniques are non-invasive methods based on nuclear magnetic resonance (NMR) principles. They are widely used in medical diagnostics, neuroscience, and research.

### Magnetic Resonance Imaging (MRI)

**Purpose:** Non-invasive imaging of soft tissues. **Principle:** Uses magnetic fields and radiofrequency pulses to align and perturb hydrogen nuclei.

see Magnetic resonance imaging

#### **Common MRI Sequences**

- **T1-weighted (T1W)** Good for anatomy.
- T2-weighted (T2W) Highlights pathology (e.g. edema).
- FLAIR Suppresses CSF signal to detect periventricular lesions.
- DWI/ADC Detects diffusion restriction (e.g. acute stroke).
- SWI Sensitive to hemorrhage and calcification.
- **fMRI** Functional mapping based on BOLD signal.
- MRA (MR Angiography) Vascular imaging without catheterization.

#### Magnetic Resonance Spectroscopy (MRS)

**Purpose:** Quantifies brain metabolites (e.g., NAA, choline, creatine). **Use:** Brain tumors, metabolic disorders, epilepsy.

# **Diffusion Imaging**

- **DWI (Diffusion-Weighted Imaging):** Highlights areas with restricted water diffusion (e.g. stroke).
- DTI (Diffusion Tensor Imaging): Maps white matter tracts using diffusion anisotropy.

# Perfusion Imaging (PWI)

Purpose: Evaluates tissue perfusion and vascular integrity. Methods:

- DSC (Dynamic Susceptibility Contrast)
- DCE (Dynamic Contrast-Enhanced)
- ASL (Arterial Spin Labeling) Contrast-free perfusion method.

#### Magnetic Resonance Fingerprinting (MRF)

**Innovative method** for simultaneous mapping of multiple tissue properties (T1, T2, etc.). **Advantages:** Faster scan, reproducible quantitative data.

#### Susceptibility-Weighted Imaging (SWI)

**Purpose:** Highlights paramagnetic substances such as deoxyhemoglobin and iron. **Use:** Microbleeds, cavernomas, venous anatomy.

#### Functional MRI (fMRI)

**Purpose:** Detects brain activation based on blood oxygenation (BOLD signal). **Applications:** Language and motor mapping, especially in presurgical planning.

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