Intro to MRI for Neurology

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MRI

- Uses magnetic field and radio-frequency of water and fat hydrogen protons
- Does not use radiation
- Multiplanar
- Imaging depends on intrinsic signal of tissue - Multimodal

- Dark on all sequences:
  - Air, dense bone, metal

- Terms –
  - Hyperintense (bright)
  - Hypointense (dark)
Transverse ("Axial")

Coronal

Sagittal
T1-Weighted Image

Dark on T1 (Low signal)
- Air
- Calcium

Gray on T1 (long T1)
- Edema
- Most lesions
- Brain
- CSF

Bright on T1 (High signal, short T1)
- Blood (sometimes)
- Fat
- Gadolinium (Gd contrast)
T1-Weighted Image

- **Purposes**
  - Useful for anatomy
  - Not very sensitive to lesions
  - Pre-contrast image
T1-Weighted Image - hemorrhage

CT (day 1)  
T1 (day 2)  
T2 (day 2)  

2290
T1-Weighted Image - hemorrhage

CT (day 16)
T1 (day 20)
T2 (day 20)
T1 Image – Recognition

- Multiple orientations
- Looks like CT
- CSF black
- Cranium bright
- Orbits bright / globe black
- Distinguish from T1 with contrast (Gd)
T1-Weighted Image with Contrast
T1-Weighted Image with Contrast

Visualization of Blood Vessels
Enhancement of lesions with BBB breakdown, esp. tumors
T2-Weighted Image

Black on T2
(Low proton signal)
- Bone
- Calcium
- Air
- Flow

Grey on T2
(Short T2)
- Brain
- Fat

Bright on T2
(Long T2 – footnote 1)
- Edema
- Most lesions
- CSF
T2-Weighted Image

- **Purposes**
  - Pathologic evaluation
  - Very sensitive for edema
  - Can’t distinguish CSF

- **Recognition**
  - CSF / sulci - bright
  - Cranium, fat - bright
  - Eyes - bright
  - Brain tissue - neutral gray
  - Abnormal tissue - bright

- **Appearance of Blood**
  - Hyperacute - bright
  - Acute - very dark
  - Subacute - bright
  - Chronic - dark
Ghostoid appearance
Rebecca Chancey sez
Northern Lights – J. Sanchez
FLAIR
FLuid Attenuated Inversion Recovery

- Form of T2-weighted image, with free water suppressed
- Pathologic evaluation
  - Non-hemorrhagic, vasogenic or cytotoxic edema
- Sometimes improves gray/white distinction
FLAIR - Recognition
FLuid Attenuated Inversion Recovery

- Cranium barely visible
- CSF suppressed - dark
- Pathology – bright
- Often bright around lateral ventricles
Hemorrhage

CT (day 1)  T1 (day 2)  T2 (day 2)

T2* (T2-star)
T2* Sequence ("T2-star")

- Susceptible to iron and calcium (decreased signal)
- Purpose
  - Evaluation of acute or chronic hemorrhage
T2* Recognition

- Like T2:
  - CSF bright; brain gray
- No cranium
- Susceptibility artifacts – dark near frontal, temporal bones
- Dark near blood or calcium
Diffusion-weighted imaging (DWI)

- Bright signal = restricted diffusion

Specific Features
- Random motion / CSF
  - Dark
- Restricted motion
  - Bright

Uses
- Early recognition of ischemia
- May also show abscess

Recognition
- Look for “DWI”, “b=1000T” or “b=900T” at bottom
- Sometimes grouped with other images (such as b=1000P)
ADC map (apparent diffusion coefficient)

Restricted diffusion = abnormal = black

Use *only* to verify DWI results