WHAT ARE THE KEY SEQUENCES IN NEURORADIOLOGY IMAGING?

Or – How do I evaluate a plain MRI of the head?
Three Key Questions

1. Is it real?
2. Is it bad?
3. What is it?
Is it real? - True Pathology vs. Artifact

- zipper artifact
- herringbone artifact
- zebra stripes
- Moire fringes
- central point artifact
- RF overflow artifacts
- inhomogeneity artifacts
- cross-talk artifact
- cross excitation
- phase-encoded motion artifact
- entry slice phenomenon
- black boundary artifact
- magic angle effect
- magnetic susceptibility artifact
- chemical shift artifact
- dielectric effect artifact
- Gibbs artifact/truncation artifact
- zero-fill artifact
- aliasing/wrap around artifact
11. Know Thy Artifact

- MR hardware and room shielding
- MR software
- Patient and physiologic motion
- Tissue heterogeneity and foreign bodies
- Fourier transform and Nyquist sampling theorem

http://radiopaedia.org/articles/mri-artifacts
Is it bad? – Normal or Abnormal
What is it?

- Take what lives there and make it abnormal.
- Know the regional pathology/pathophysiology.
- Compare unknown to known.
- How do these pathologies appear on MRI?
Contrast

- Tissue definition/Spatial resolution
- Conspicuity of pathology

Where is it easier to identify the stroke?
Basic Contrasts
T1 contrast

Better tissue difference $\Leftrightarrow$ better T1 contrast

FAT

CSF

no tissue difference $\Rightarrow$ poor T1 contrast

SIGNAL INTENSITY

Time

SHORT TR (500 MS)

LONG TR (1500 MS)
Basic Neuro Sequences

- Four Shades of Gray – T1

Black: No protons / excited protons
- Air
- Dense Calcification/Cortical Bone

Dark: Fluid (CSF)

Intermediate: (Protein)
- Brain Tissue
- GM
- WM

White: Fat
- Gadolinium
- Methemoglobin
Sagittal T1

Intermediate

Black

White

Dark
Sagittal T1
T1 contrast
T2 contrast

signal intensity

Short TE, signal differences between tissues are small

Long TE, signal differences between tissues are large

FAT

CSF

25ms

100 ms

TE(ms)
Basic Neuro Sequences

- Four Shades of Gray – T2

- Black:
  - No protons / excited protons
    - Air
    - Dense Calcification
    - Flow voids

- Dark:
  - (Protein)
  - Bound water tissues (muscle)

- Intermediate:
  - Brain Tissue
    - WM
    - GM

- White:
  - Free water
  - Fat
  - Oxyhemoglobin
3D T2 imaging

CISS/FIESTA
Selective Nulling of Tissue Signal
By Choice of TI

inversion time (TI)

Signal Generated
(Magnitude Image)
Selective Nulling of Signals based on TI

- STIR: TI = 180 msec, Fat suppressed
- T2-FLAIR: TI = 2500 msec, CSF suppressed
- TI = 400 msec, White Matter suppressed
Basic Neuro Sequences

- Four Shades of Gray – FLAIR

<table>
<thead>
<tr>
<th>Black</th>
<th>White</th>
<th>Free water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark</td>
<td>Intermediate</td>
<td>Brain Tissue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T2 bright tissue that isn't free water.</td>
</tr>
</tbody>
</table>

WM GM
Diffusion Weighted Imaging

- Black
- Dark
- Intermediate
- White

Non fluid-restricted tissue
Fluid-restricted tissue (maybe)
Diffusion Weighted Imaging

Dephasing Gradient

\[ \text{H}_2\text{O} \]

Rephasing Gradient

\[ \text{H}_2\text{O} \]
Not all that shines is gold
Diffusion Weighted Imaging - ADC

Apparent Diffusion Coefficient – ADC MAP
• A measure of magnitude of diffusion

- Black: True Fluid Restriction
- Dark: Not Fluid Restriction (T2 Shine Through)
- Intermediate: Not Fluid Restriction (T2 Shine Through)
- White: Not Fluid Restriction (T2 Shine Through)
T2* Images

Imaging of tissues which cause non-homogeneous magnetic susceptibility effects

- Calcium
- Hemosiderin
Summary

Know your:
- Physics
- Neuroanatomy
- Artifacts

Ask yourself:
- Is it real?
- Is it bad?
- What is it?

Sequences
- T1 Gd
- T2
- FLAIR
- DWI
- T2*