Abstract

- This course will teach the participant to identify common artifacts found clinically in MR, DR, CT, PET, to determine the causes of artifacts, and to make recommendations for how to resolve artifacts.

Learning Objectives

1. Identify common artifacts found clinically
2. Determine causes of various clinical artifacts
3. Describe how to resolve various clinical artifacts
Speakers
- Robert Pooley – MRI
- Beth Schueler - Digital Radiography
- Jim Kofler - CT
- Brad Kemp - PET

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IDENTIFYING IMAGE ARTIFACTS, THEIR CAUSES, AND HOW TO FIX THEM:
MR

Outline: Artifact Identification, Cause, How to Fix
- Motion / ghosting
- Aliasing / wrap
- Radiofrequency interference
- Metal
- Corduroy
Motion / Ghosting

- Identification:
  - May appear as repetition of “ghosts” across image, may be distinct or blurred depending on type of motion
  - Typically occurs in phase encoding direction

- Causes:
  - Patient motion, physiologic / involuntary, voluntary; equipment vibration / instability

Image space

k-space

K-space trajectory

1 2 3 4 5 6 7 8 9

Kx

Ky
Propeller / Blade

- Reduce sensitivity to motion
- May be used for uncooperative patients

Motion / ghosting

- Remind patient to hold still, make patient more comfortable, decrease scan time, consider sedation
- Use respiratory triggering / navigator pulses, motion correction, breath-hold options when available
- Implement Propeller / Blade sequence options
- Address equipment problems, test with phantom, test with cold-head off
- Swap phase and frequency if artifact obscures pathology
Aliasing / wrap

- **Identification:**
  - Patient anatomy appears in incorrect locations

- **Causes:**
  - Insufficient sampling
  - Small FOV with anatomy (signal) outside FOV
Aliasing / wrap

- How to fix:
  - Increase FOV
  - Increase over-sampling in phase encoding and/or slice directions (for 3D)
  - Use saturation bands for anatomy outside FOV
  - Turn off coils outside imaging volume

RF Interference / Zippers

- Identification:
  - Typically appears as single or multiple lines ("zipper") in the phase encoding direction

- Causes:
  - Unexpected radiofrequency signal from equipment inside room, or outside room with poor RF shielding
RF Interference / Zippers

- How to fix:
  - Identify source, replace electronic components generating unwanted RF signal
  - Check integrity of RF shielding, clean RF door threshold and RF fingers / plates

Metal

- Identification:
  - Signal void, often with adjacent very bright signal
  - Geometric distortion

- Causes:
  - Magnetic susceptibility, induced eddy currents, spin dephasing
Metal

- How to fix / reduce:
  - Properly screen patient, remove any metal that can be removed
  - Turbo spin echo and spin echo sequences reduce artifact compared to gradient echo
  - Decrease TE and echo spacing; increase bandwidth and resolution in frequency encoding direction
  - Swap phase and frequency to modify shape

Corduroy

- Identification:
  - Pattern of regularly spaced lines extending across image
  - Can occur at different spatial frequencies and different angles
  - Multiple sets can combine to appear as a cross hatch pattern

- Causes:
  - Spike(s) in k-space

Image space  k-space

FT
Image space ↔ k-space

FT
Corduroy

- How to fix:
  - Confirm room humidity in specification
  - Perform scanner spike check
  - Attempt to localize source if in room
  - Call Service
Bonus Artifact:

Reddit: "Camera Malfunction"
Courtesy Catherine Sturchio

Suggested Reading
- Dietrich, “Artifacts in 3-Tesla MRI: Physical background and reduction strategies” EJR 2008 65(1) 29-35

Thank You
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Flow

- Identification:
  - Ghosting, appears as repetition (phase encoding direction) of blood

- Causes:
  - Velocity induced phase effects
Flow

- How to fix:
  - Gradient moment nulling / flow compensation
  - Spatial saturation bands
  - Swap phase and frequency if artifact mimics pathology