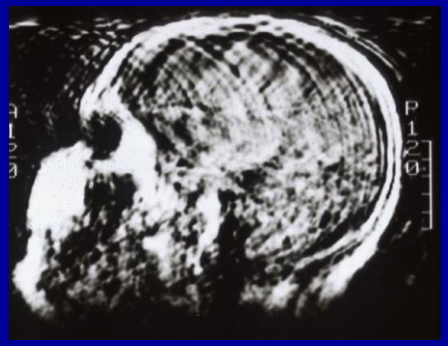
Guess the Artifact



- Where is it?
- What is it?
- How is it caused?
- What can you do about it?

Guess the Artifact: #1

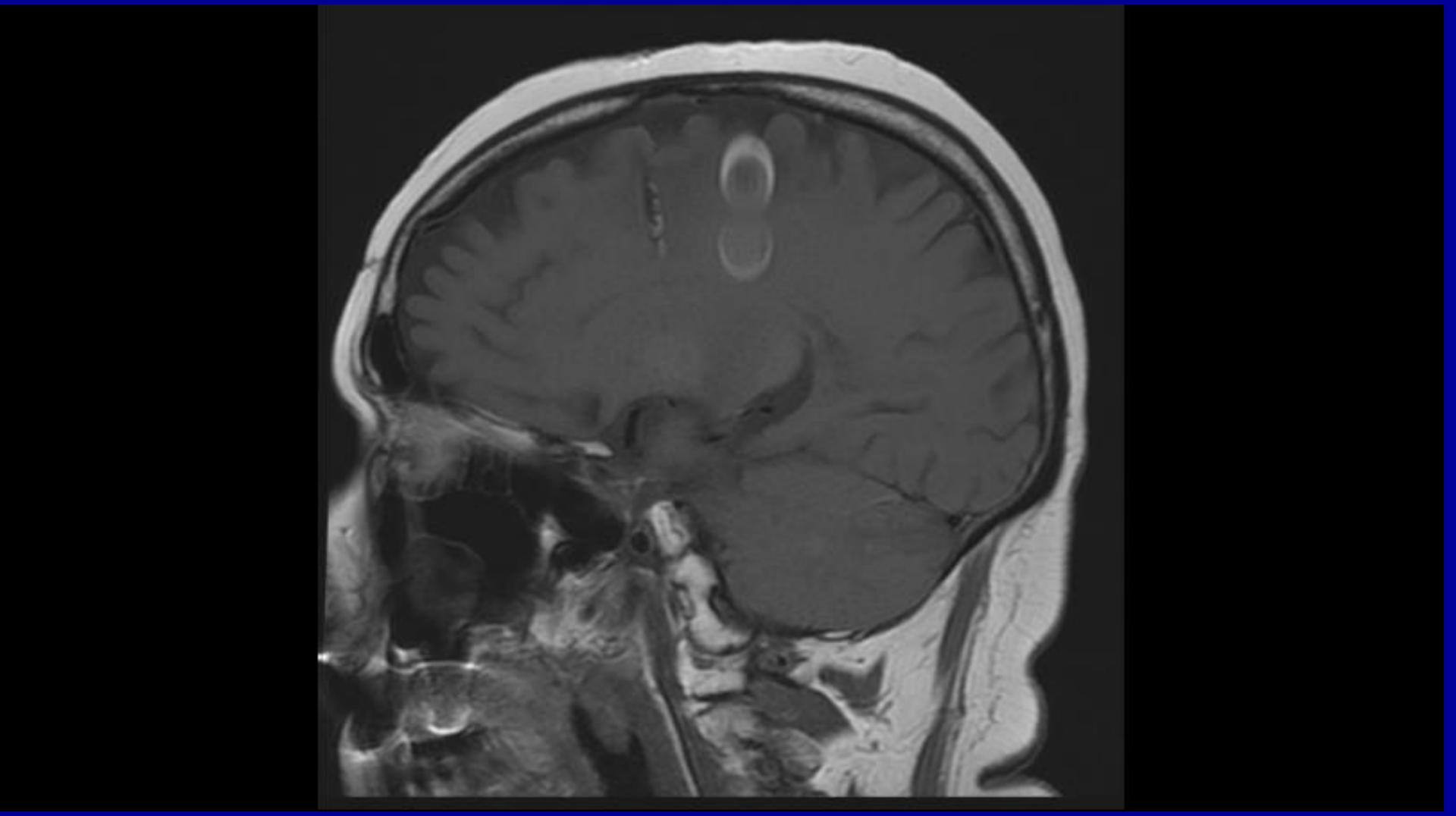
Where is it?

What is it?

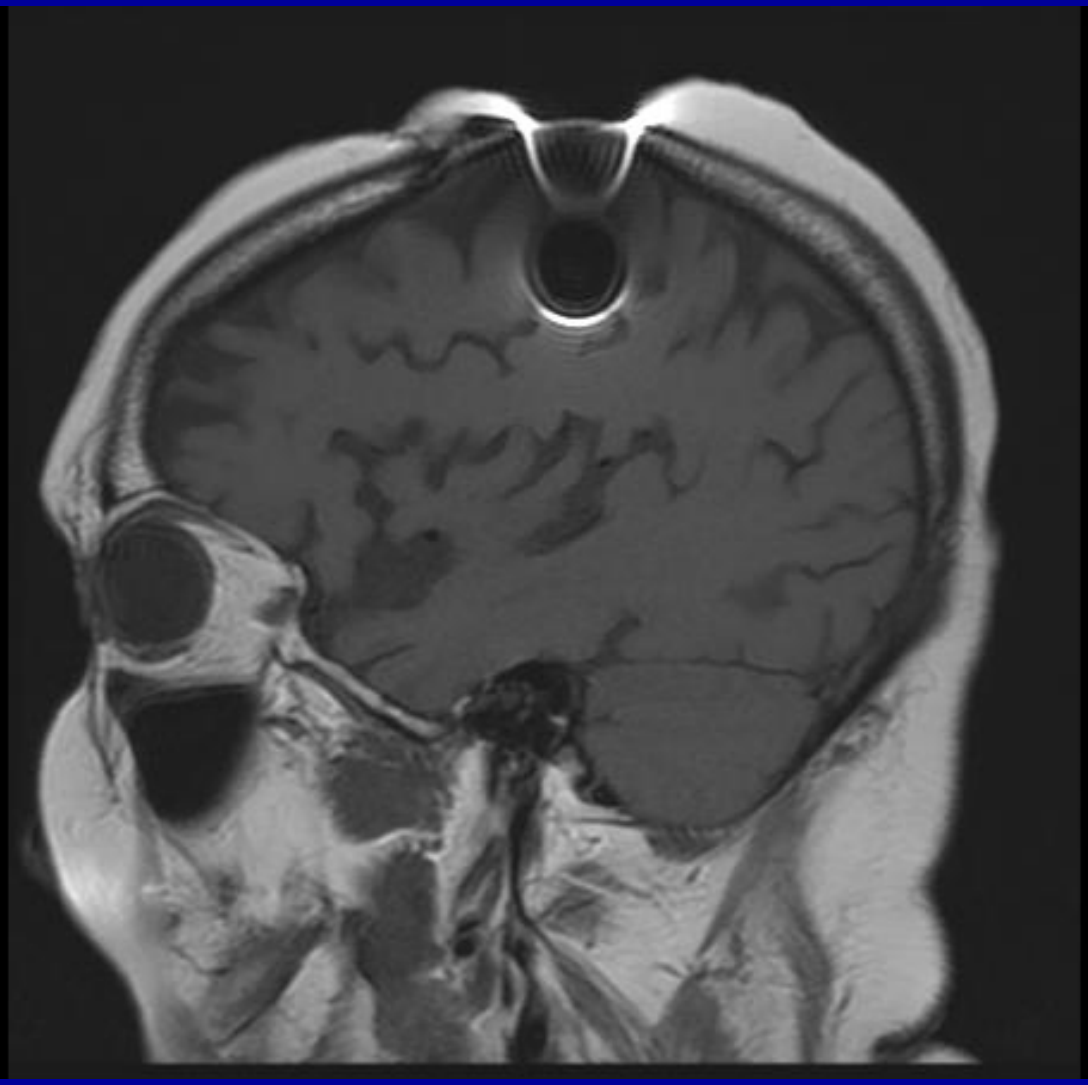
How is it caused?

What can you do about it?

Guess the Artifact: #1



Guess the Artifact: #1



1. Susceptibility Artifacts

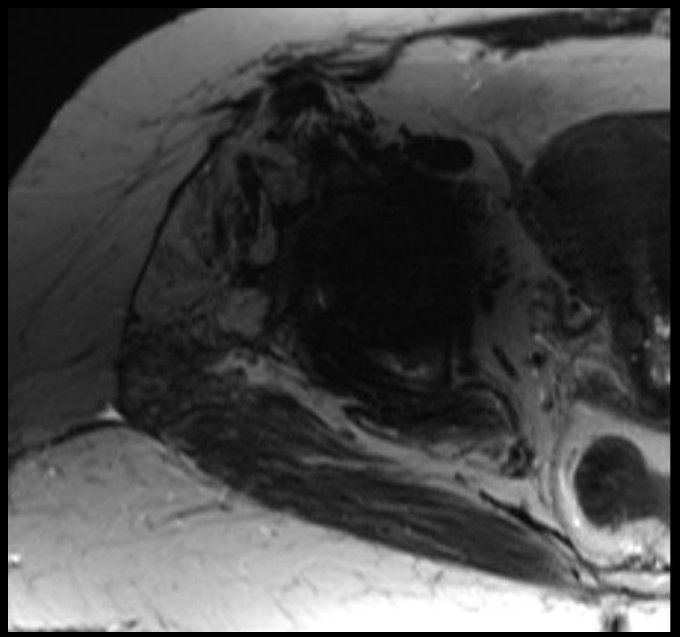
- Variations in the magnetic field strength that occur near the interfaces of substances of different magnetic susceptibility such as ferromagnetic foreign bodies.
- Causes dephasing of spins and frequency shifts of the surrounding tissue.
- Worst with long echo times and with gradient echo sequences and at higher field strengths.

1. Susceptibility Artifacts

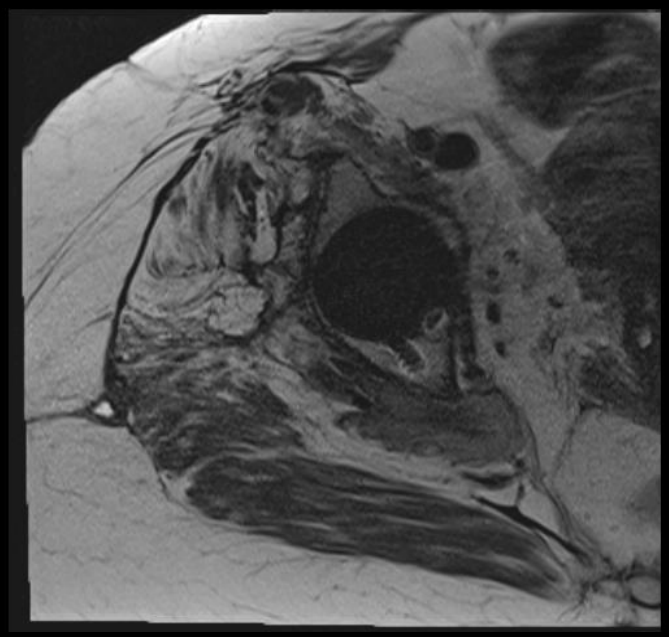
Solutions

- Consider spin-echo instead of gradient-echo based sequences.
- Increase bandwidth and reduce TE in GRE sequences.
- In the presence of implants, consider special Metal Artifact Reduction sequences.

1. Susceptibility Artifacts



TSE



TSE with high BW

Artifact from metal implant is reduced in the TSE sequence by increasing the bandwidth.

Guess the Artifact: #2

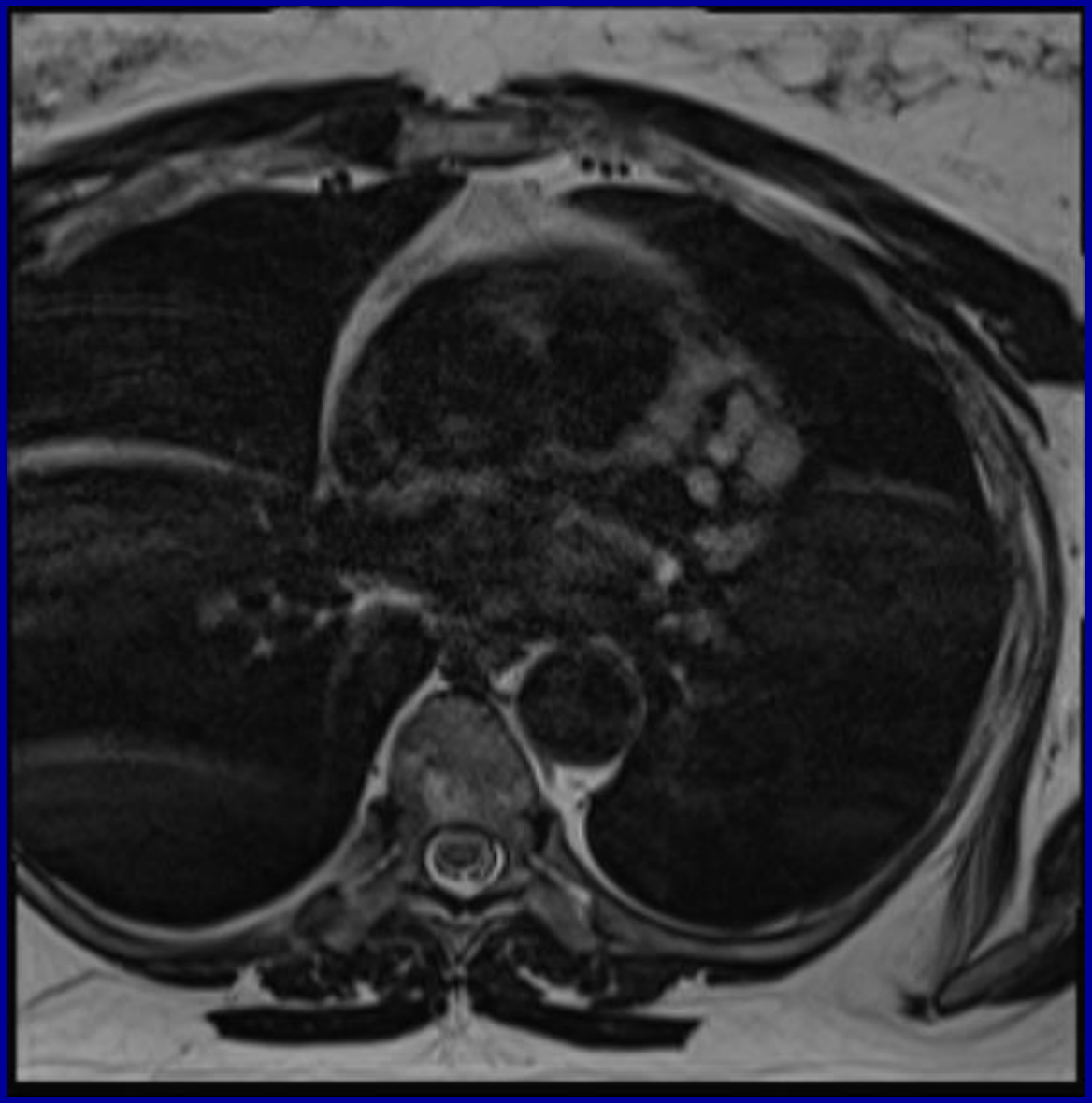
Where is it?

What is it?

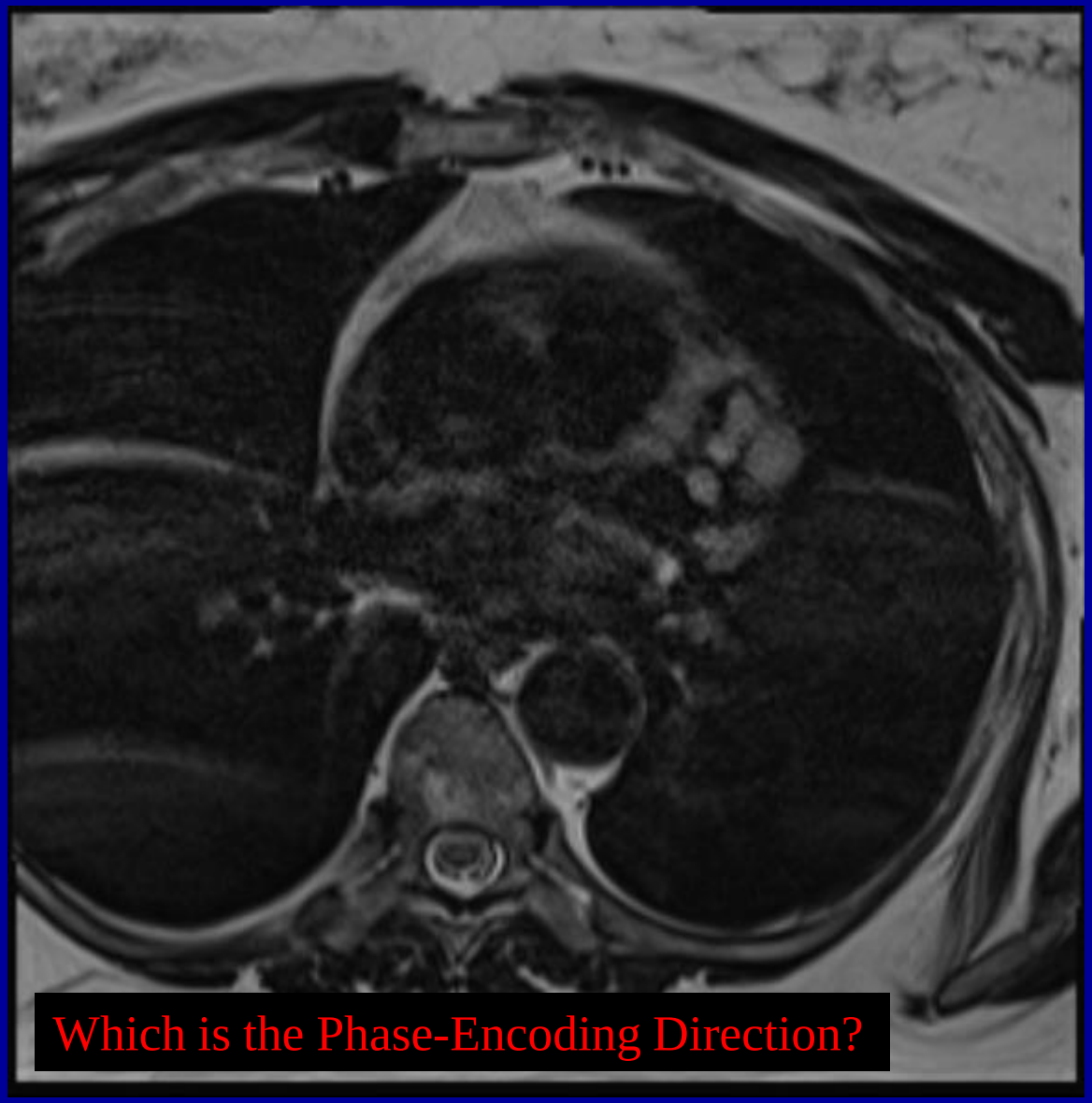
How is it caused?

What can you do about it?

Guess the Artifact: #2



Guess the Artifact: #2



2. Motion Artifacts

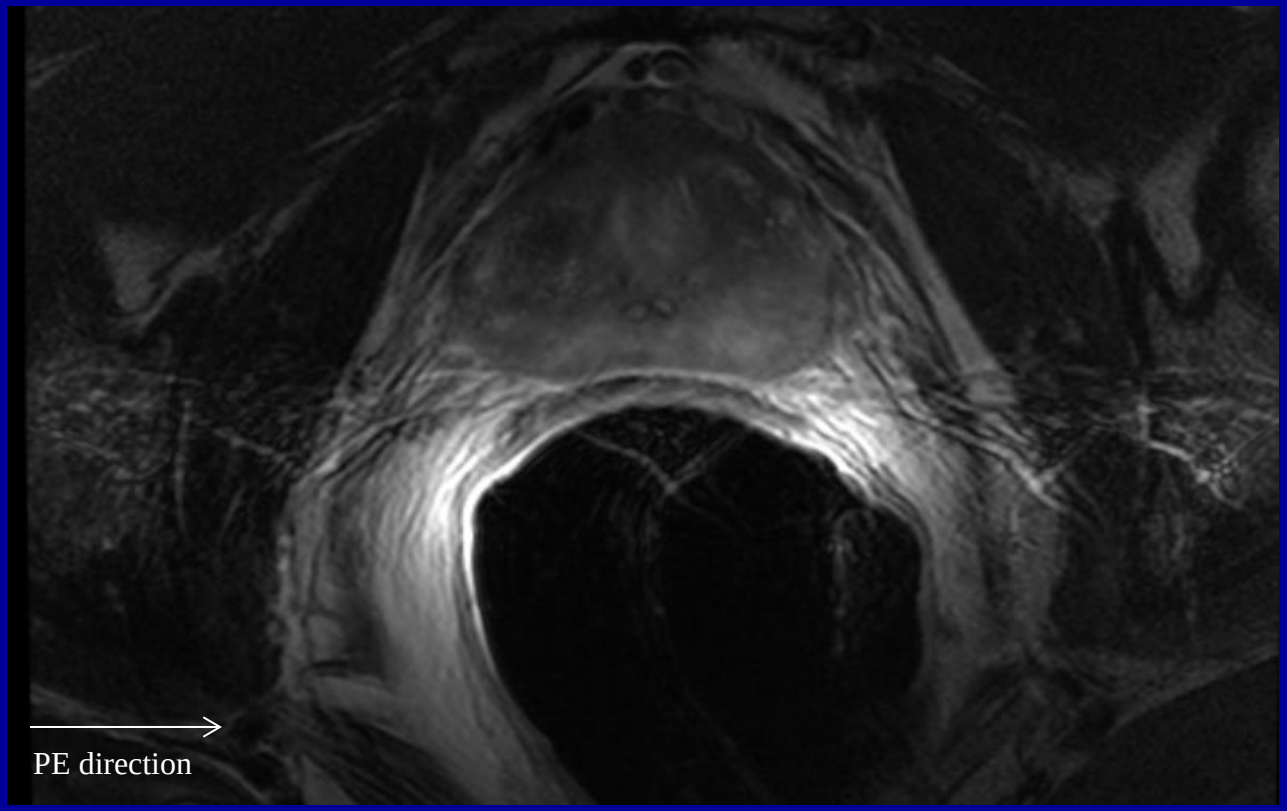
- Bright noise or repeating densities usually oriented in the phase direction.
- Often extend across the entire FOV, unlike truncation artifacts that diminish quickly away from the boundary causing them.
- Examples: Arterial pulsations, CSF pulsations, swallowing, breathing, peristalsis, and physical movement.

2. Motion Artifacts

Solutions

- Arterial and CSF pulsation artifacts can be reduced with flow compensation and cardiac gating.
- Spatial pre-saturation can reduce some swallowing and breathing artifacts and arterial pulsations.
- Fast imaging can eliminate motion artifact

2. Motion Artifacts



Motion causes serious artifact in the phase-encode direction in this prostate TSE. Choosing the correct PE direction is critical in obtaining diagnostic images.

Guess the Artifact: #3

Where is it?

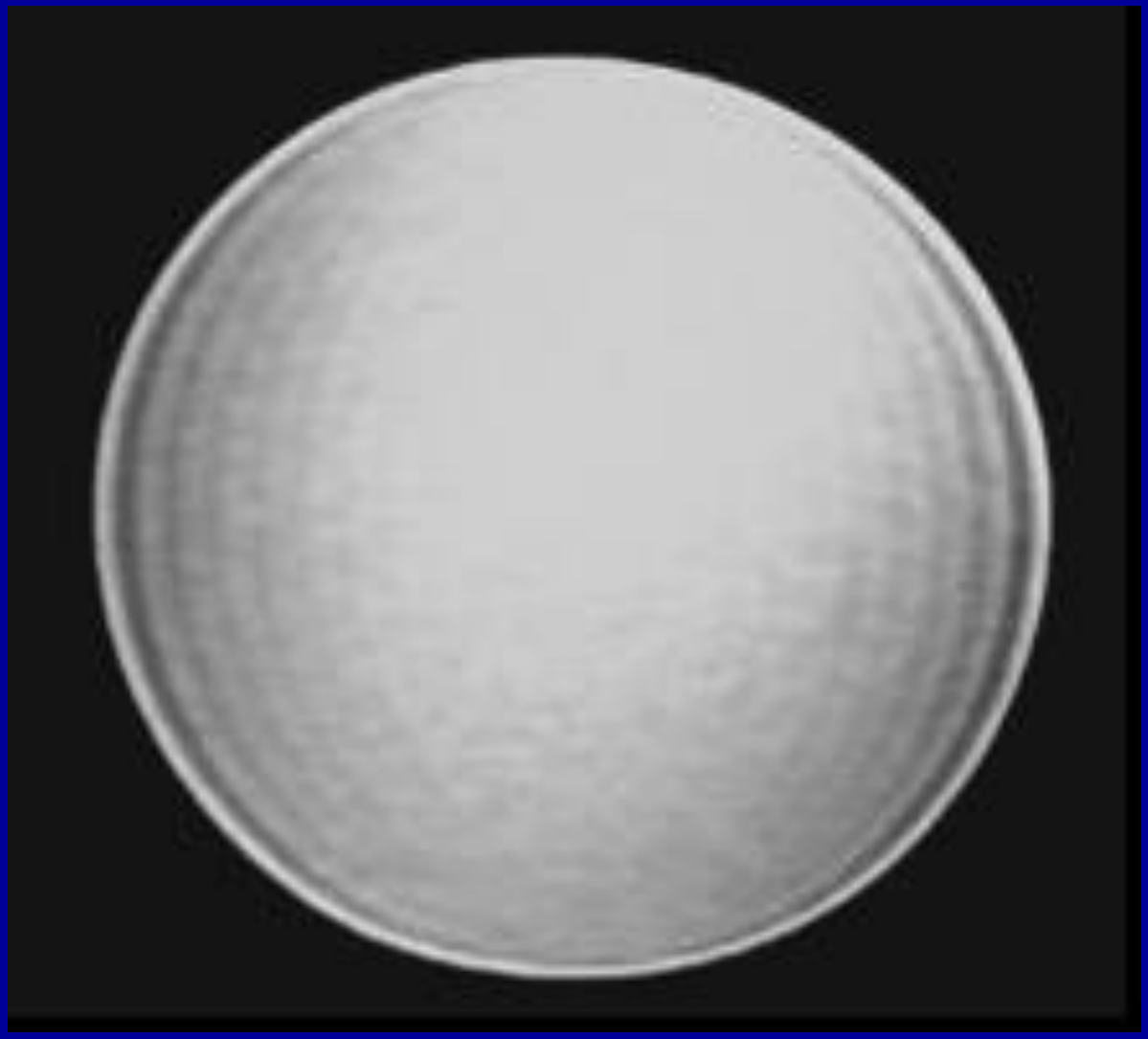
What is it?

How is it caused?

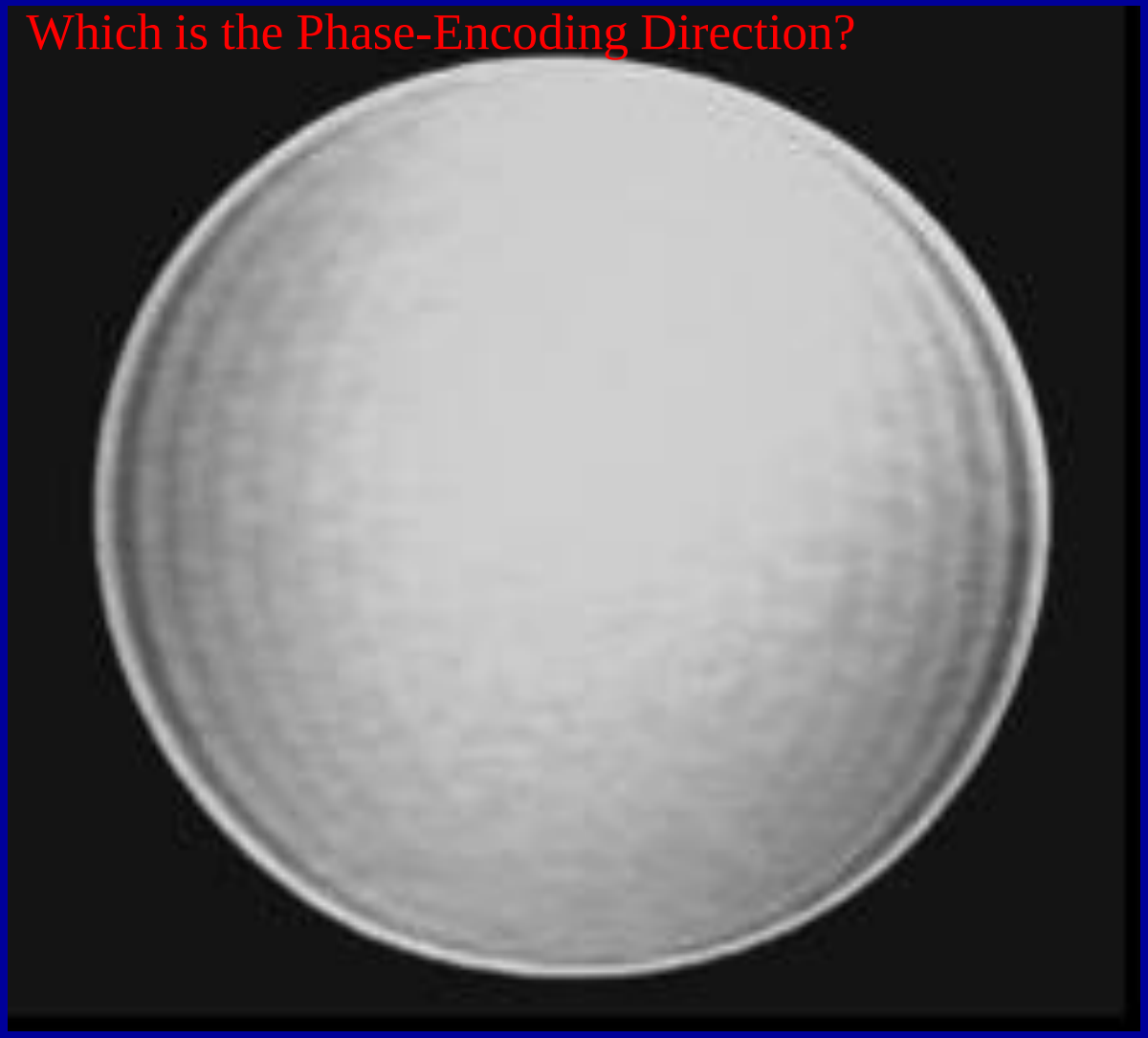
What can you do about it?

Guess the Artifact: #3

Guess the Artifact: #3



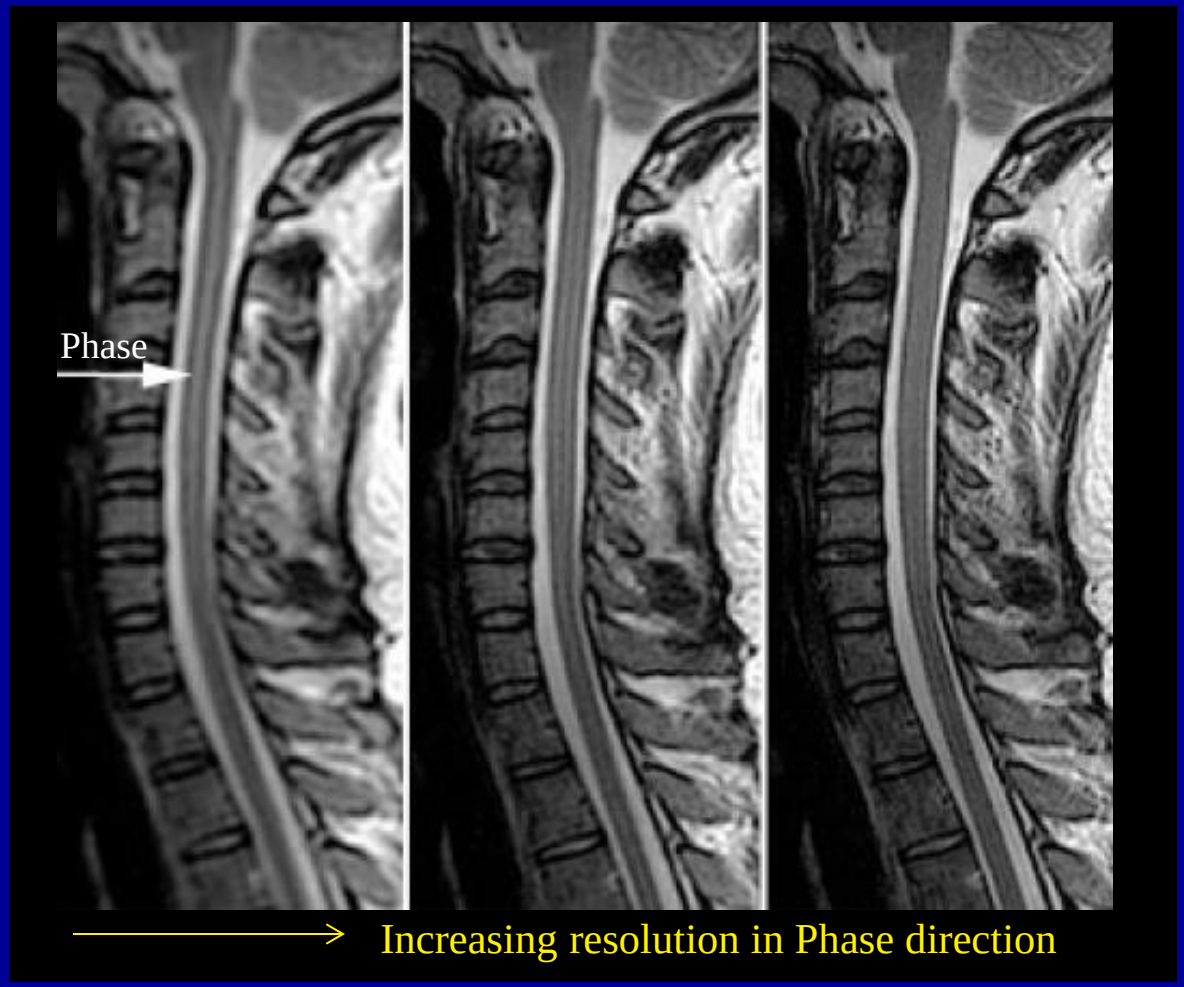
Guess the Artifact: #3



3. Gibbs or Truncation Artifact

- Bright or dark lines that are seen parallel & next to borders of abrupt intensity change.
- Related to the finite number of encoding steps used by the Fourier transform.
- Solutions: More encoding steps lessen the intensity and narrows the artifact. Filtering is also a solution although leads to loss of resolution.

3. Gibbs or Truncation Artifact



Guess the Artifact: #4

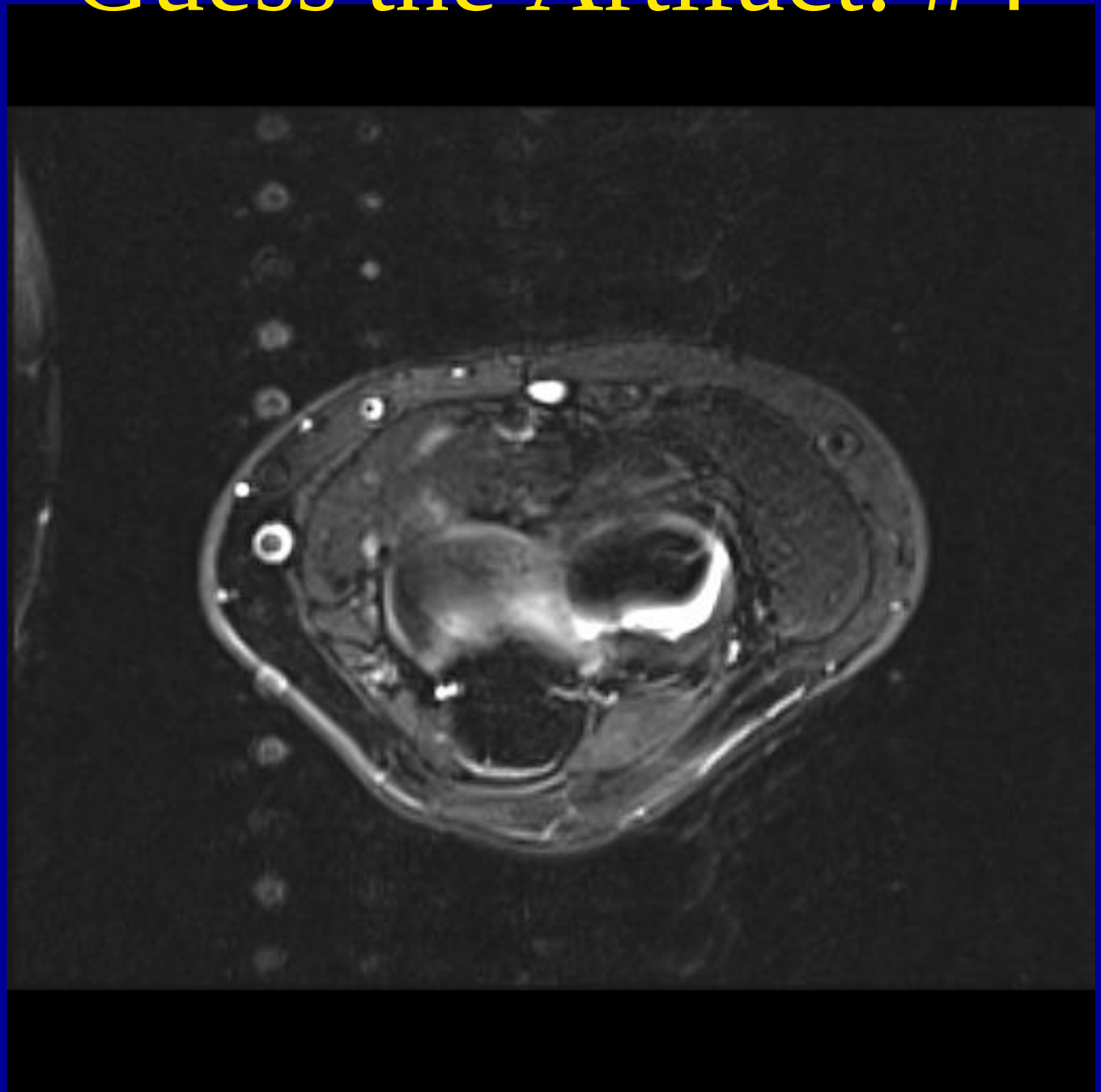
Where is it?

What is it?

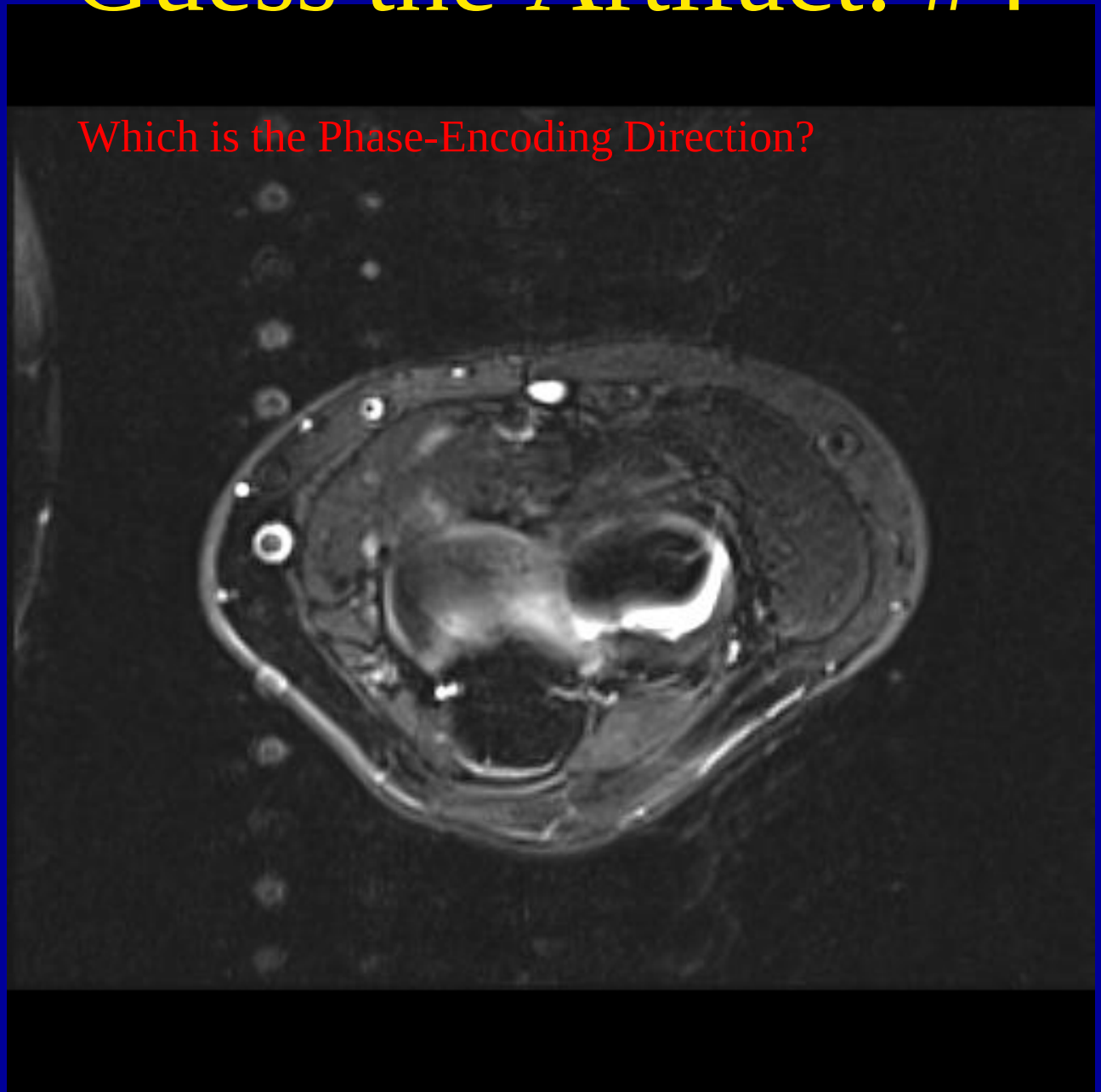
How is it caused?

What can you do about it?

Guess the Artifact: #4



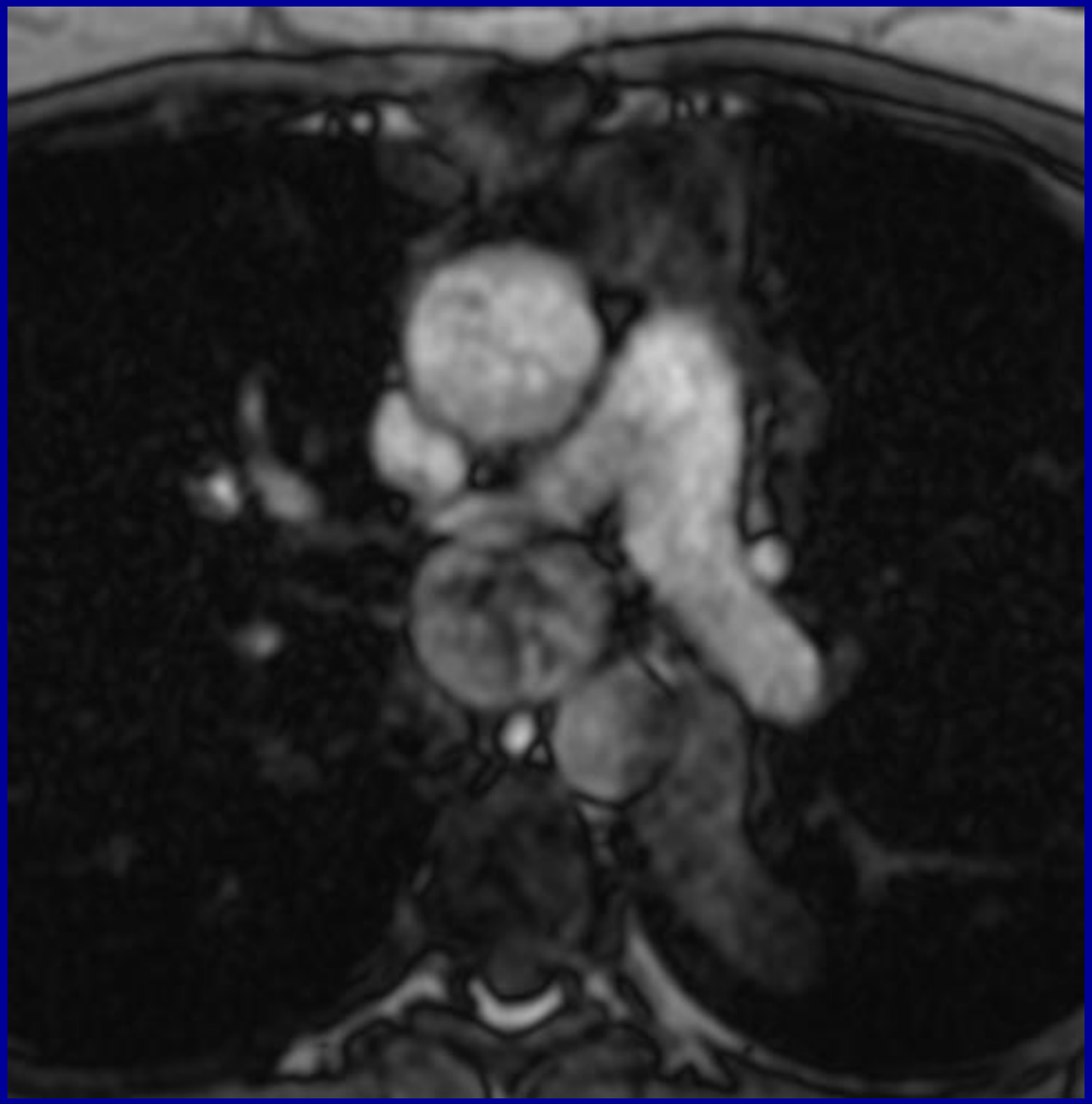
Guess the Artifact: #4



4. Flow ghosting

- Primarily along the phase-encoding direction.
- Due to change in blood flow during imaging - e.g. pulsatile flow.
- Causes copies or *ghosts*
- Solutions: Use flow compensation, saturate the blood signal, use gating.

4. Flow ghosting? – describe it.



Guess the Artifact: #5

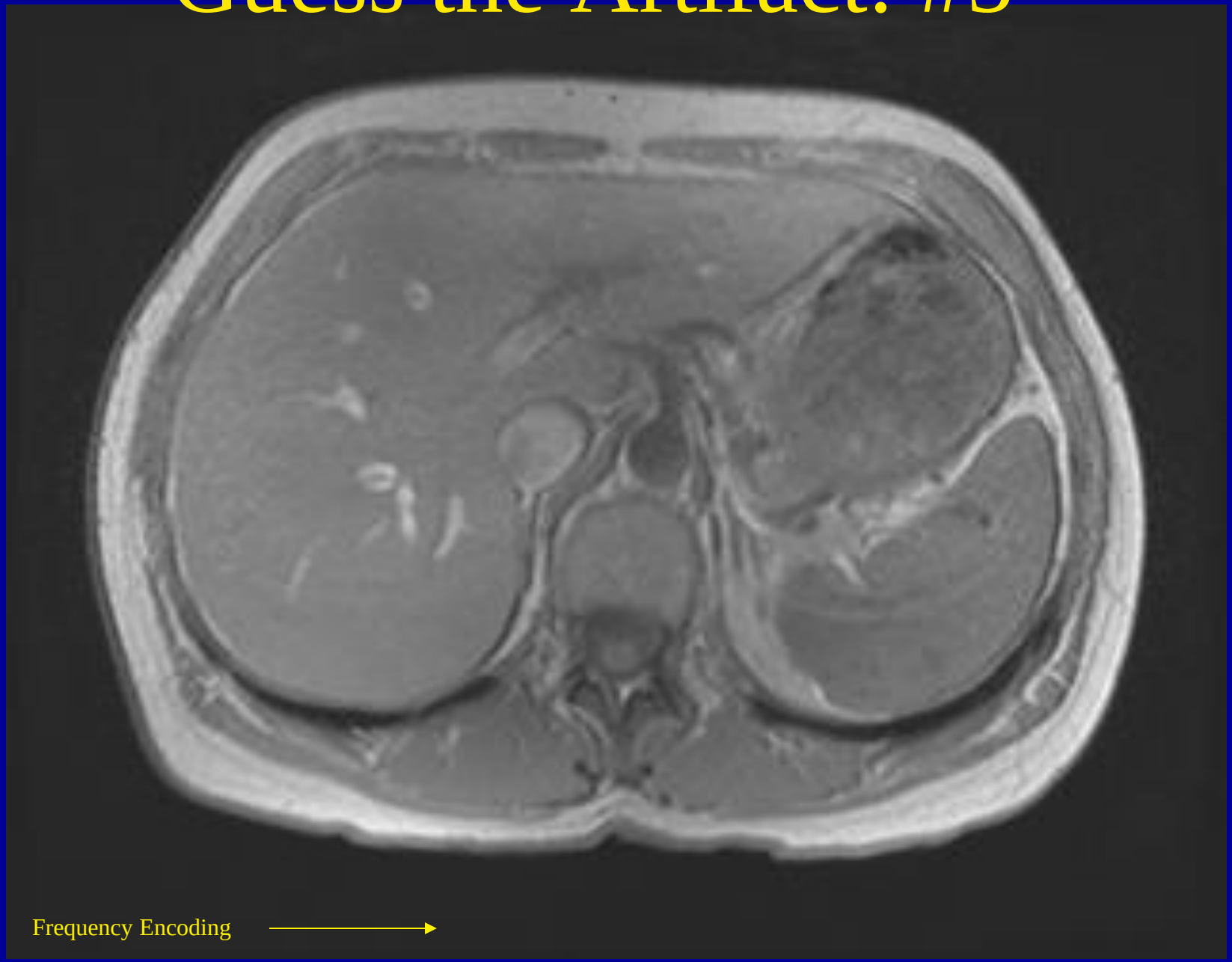
Where is it?

What is it?

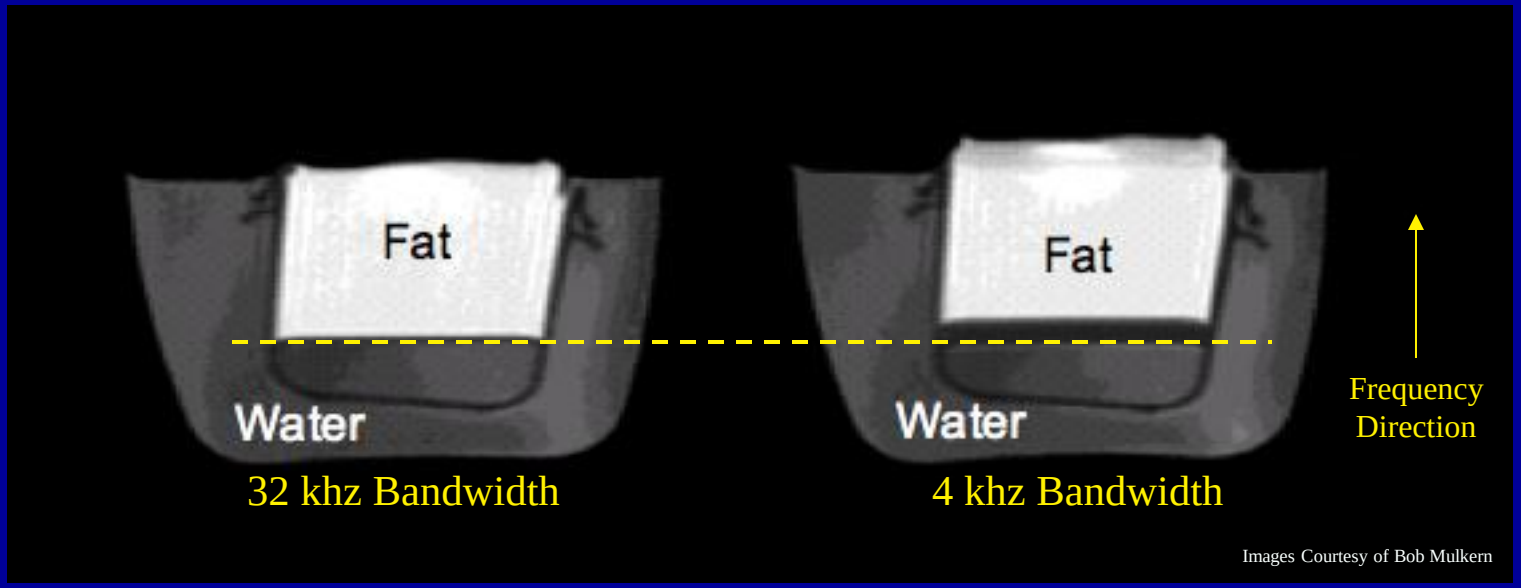
How is it caused?

What can you do about it?

Guess the Artifact: #5



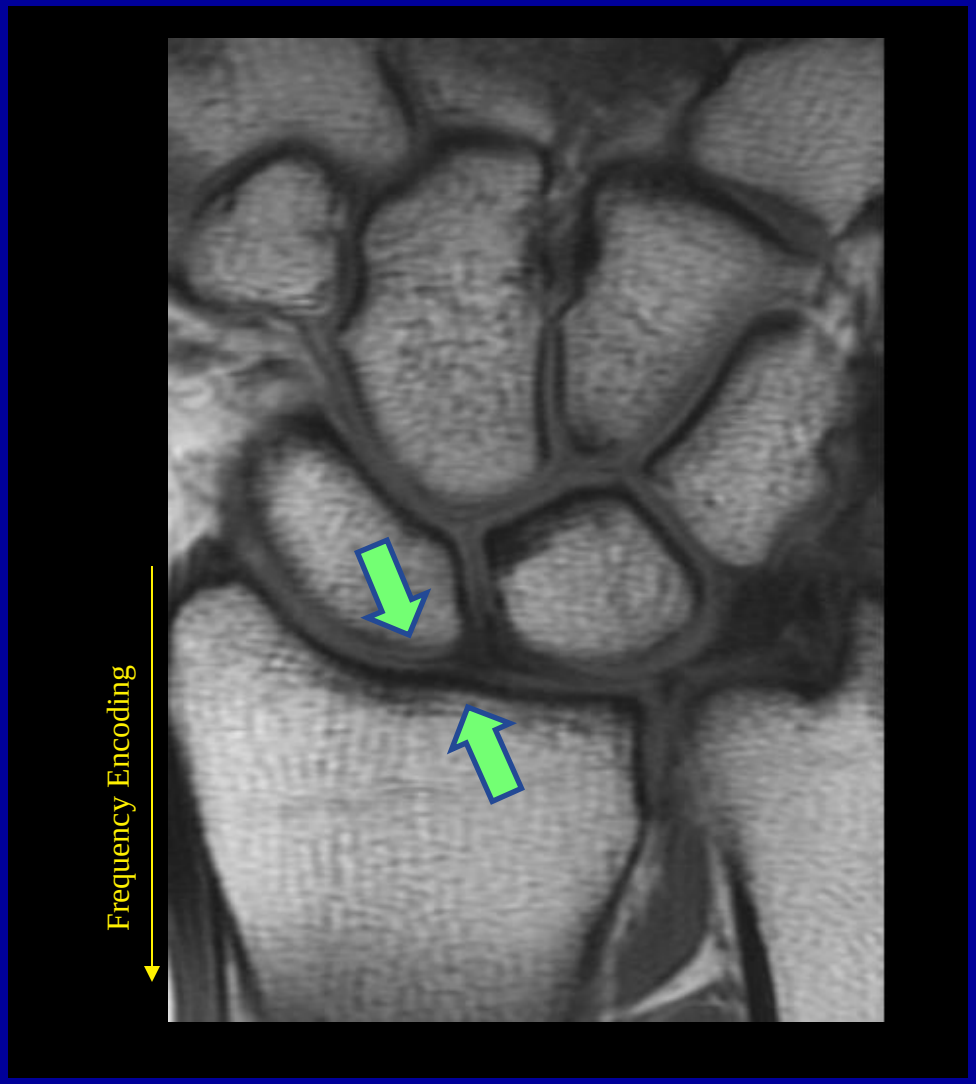
Guess the Artifact: #5



5. Chemical-shift Artifact

- Occurs in frequency-encoding direction
- The different resonant frequency of fat and water is transformed into a spatial shift in position.
- Common in vertebral bodies, orbits, solid organs surrounded by fat.
- Worst at higher field strength.
- (Also much worse in EPI)
- Solutions: Use higher bandwidth. Or fat suppression.

5. Chemical-shift Artifact



Guess the Artifact: #6

Where is it?

What is it?

How is it caused?

What can you do about it?

Guess the Artifact: #6

Guess the Artifact: #6

Image Courtesy of Bob Mulkern

Guess the Artifact: #6

6. Moire Fringes: Wrap-around

- Moire fringes are an interference pattern most commonly seen in gradient echo images.
- Caused by wrapping (or aliasing) of one side of the body to the other resulting in superimposition of signals of different phases.
- Solutions: Increase the FOV, saturate signal at the edge of the FOV.

Guess the Artifact: #7

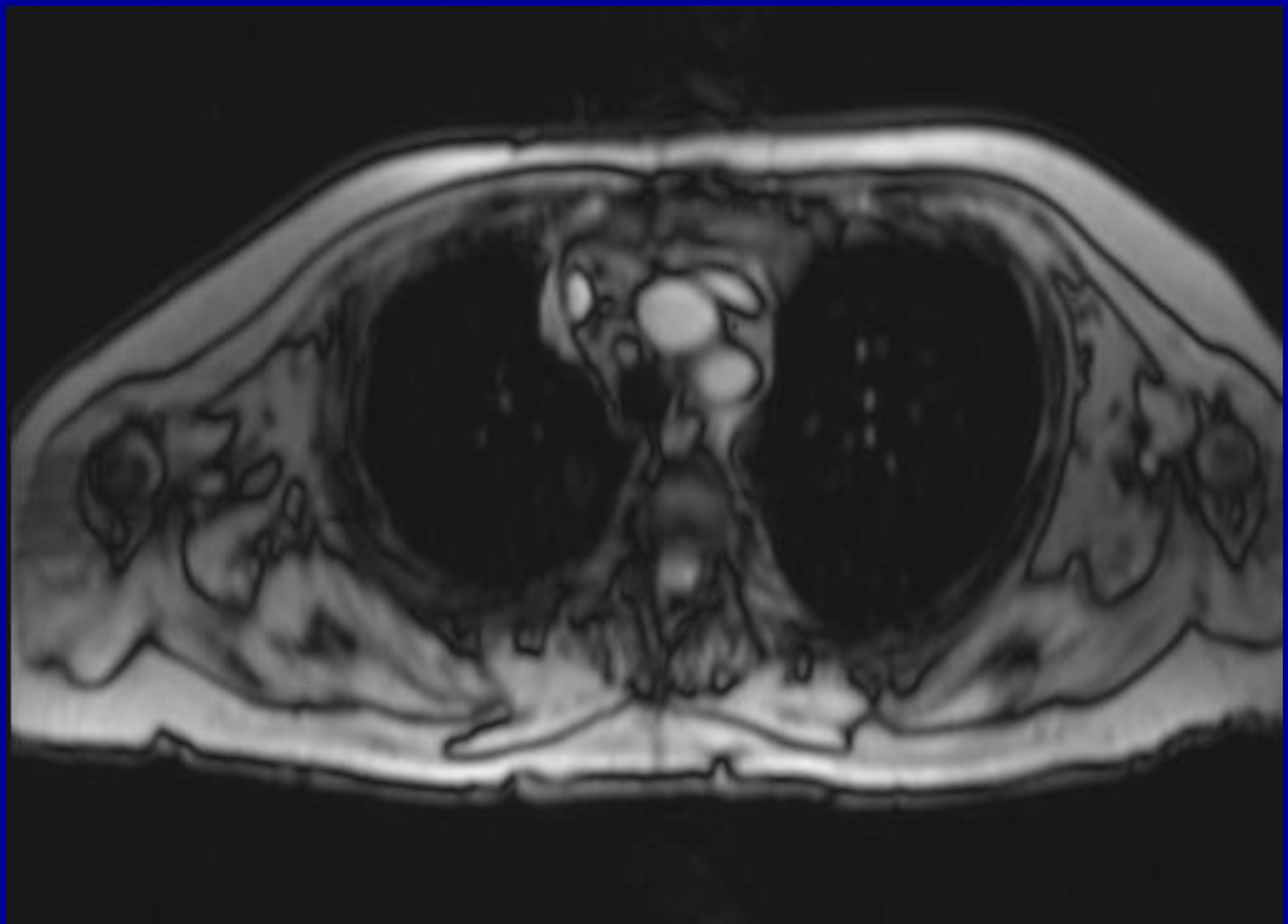
Where is it?

What is it?

How is it caused?

What can you do about it?

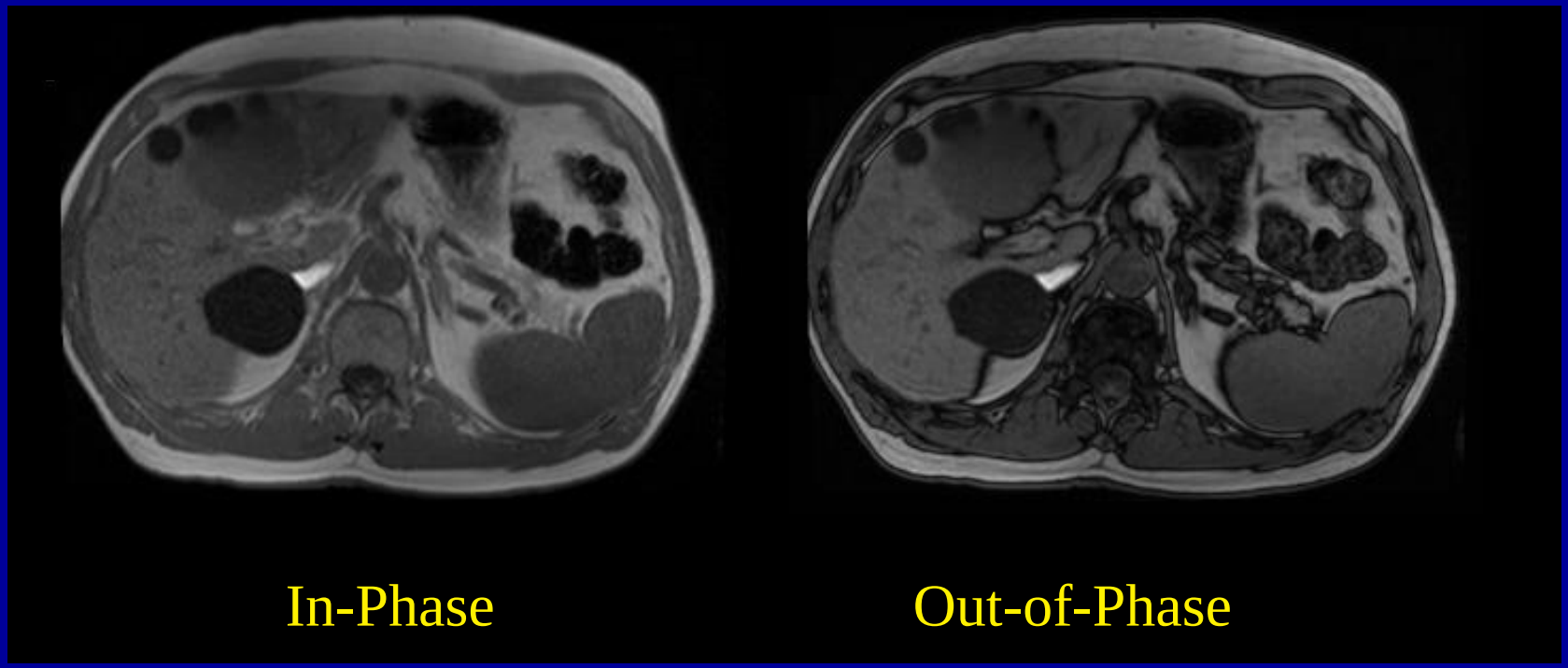
Guess the Artifact: #7



7. Black-Line Artifact

- An artificially created black line located at fat-water interfaces such as muscle-fat interfaces.
- Occurs at TE when the fat and water spins located in the same pixel are out of phase, cancelling each other's signal. Particularly noticeable on gradient-echo sequences. Seen in both the frequency and phase directions.
- Solutions: Alter the TE

7. Black-Line Artifact



In-Phase

Out-of-Phase

Guess the Artifact: #8

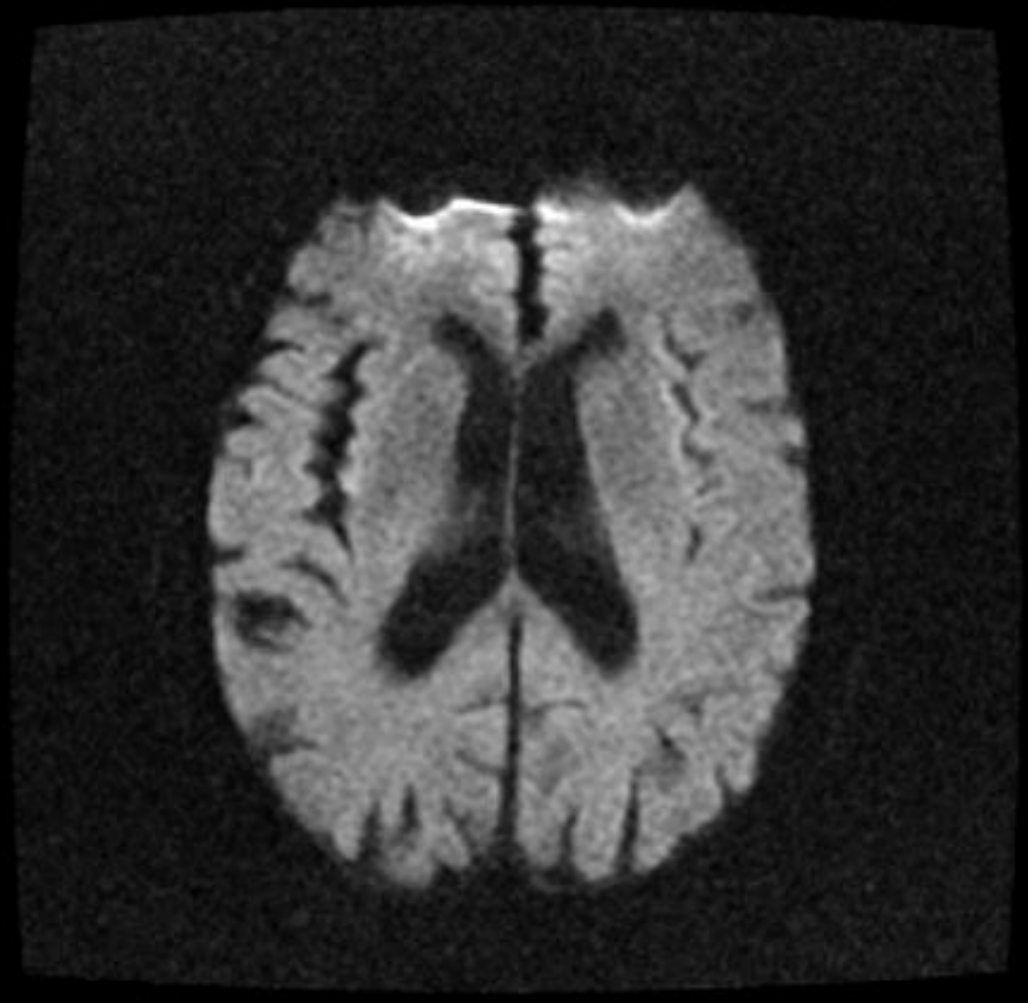
Where is it?

What is it?

How is it caused?

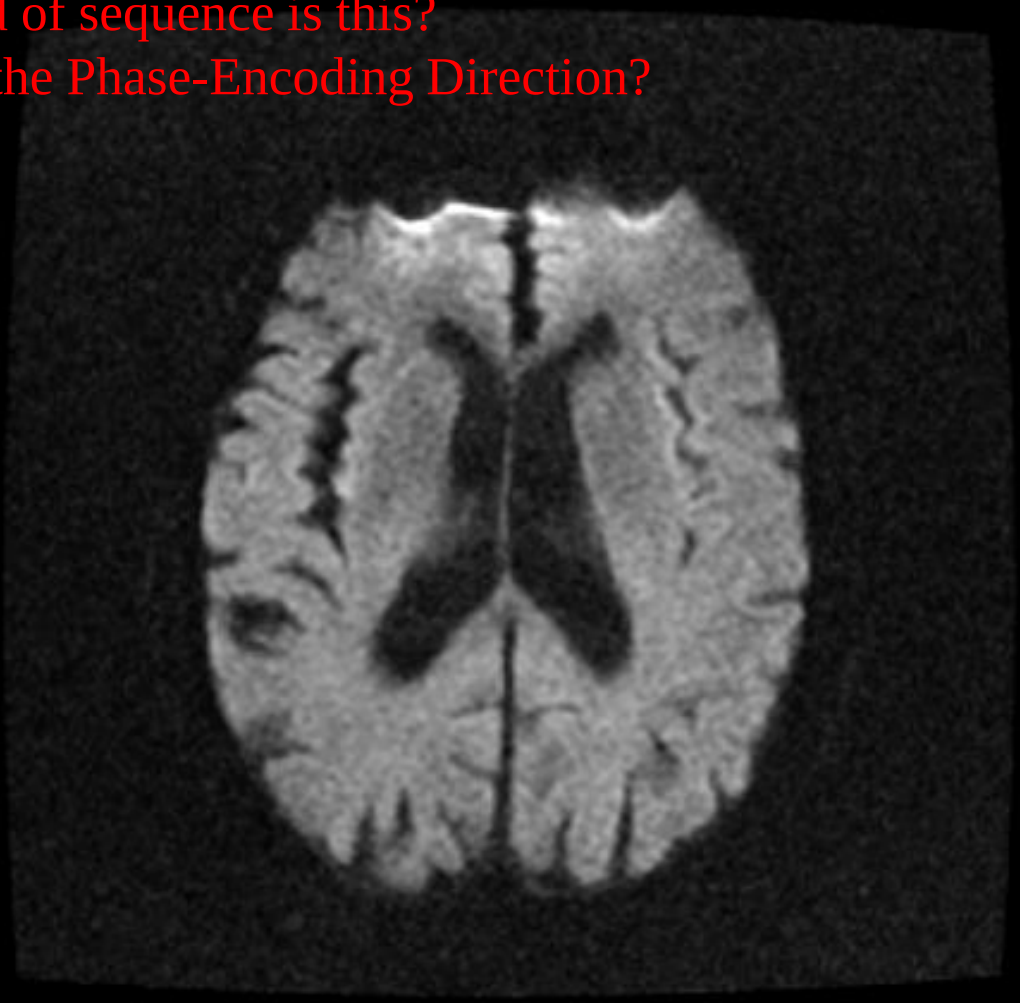
What can you do about it?

Guess the Artifact: #8



Guess the Artifact: #8

What kind of sequence is this?
Which is the Phase-Encoding Direction?



8. Susceptibility Distortion

- Caused by variations in the magnetic field gradient that occurs near air-tissue interfaces. Since the gradient encodes spatial information, this confuses the imaging method.

- EPI is especially sensitive to susceptibility effects.

- Solutions: Can be improved by using parallel imaging or consider multi-shot EPI. Reduced FOV imaging (in the phase direction) might also help.

Guess the Artifact: #9

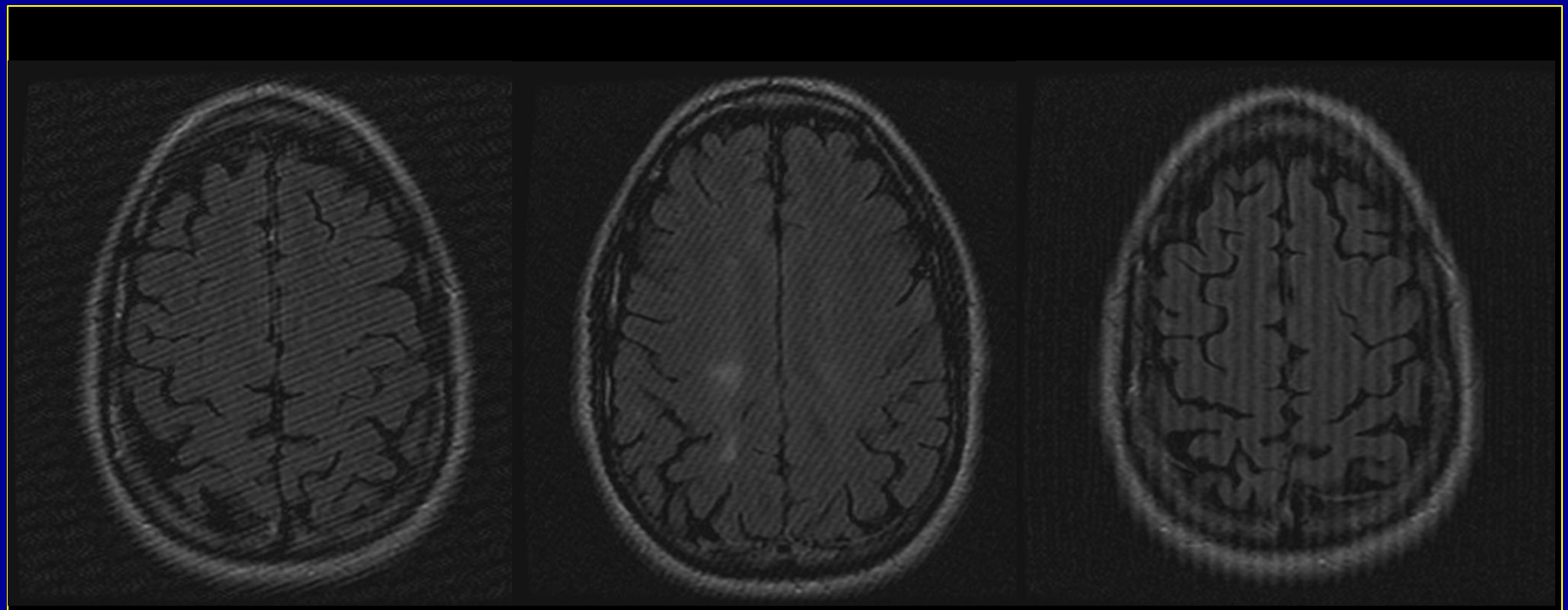
Where is it?

What is it?

How is it caused?

What can you do about it?

Guess the Artifact: #9



Three slices from the same exam. Not all slices in series had artifact.

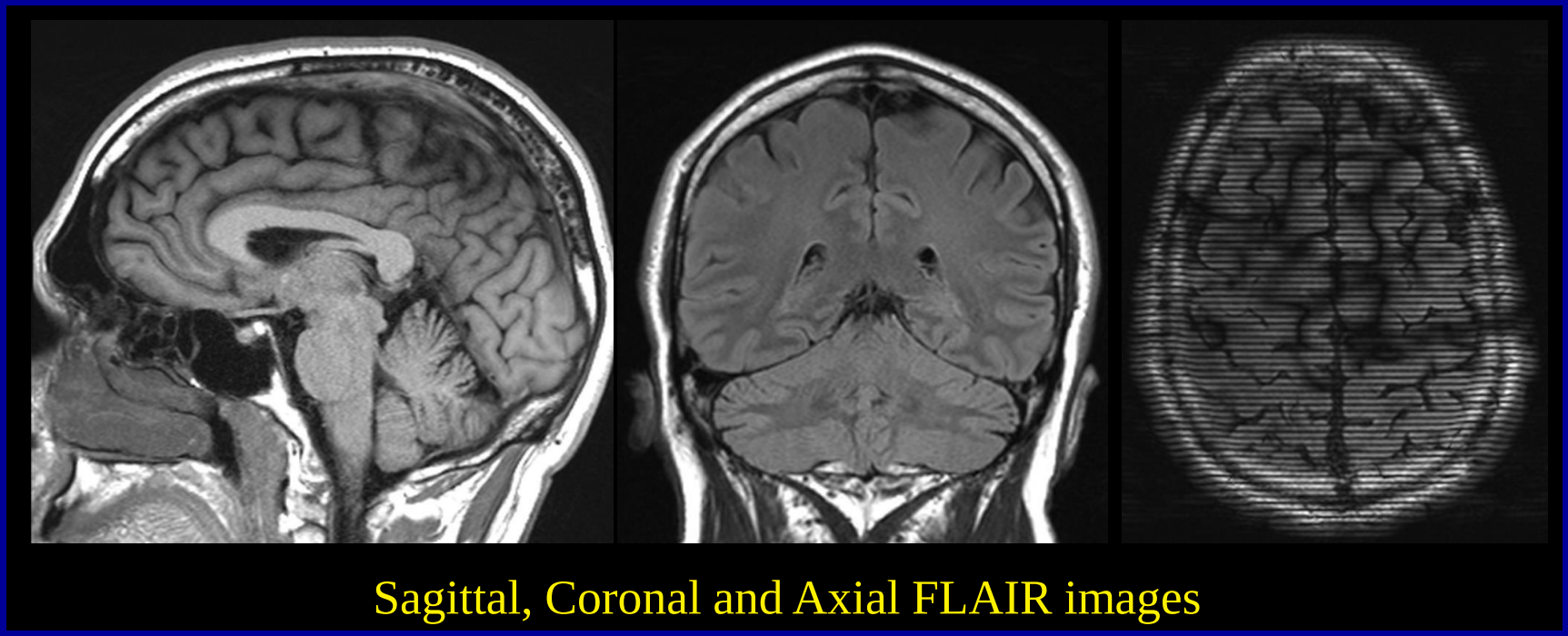
9. k-Space Spike Artifact

- Caused by the presence of high intensity spikes in the raw k-space data array (e.g. created by loose cable moving in the magnetic field).

- Spikes (spurious data values) in k-space result in regular line patterns in images.

- Solutions: Try re-plugging the receiver coil. Contact service engineer for maintenance if problem is persistent.

‘Machine’ Artifact



Sagittal, Coronal and Axial FLAIR images

Artifact seen in axial images only. Cables were attached by researcher to the system cabinet. When the cables were removed the artifact disappeared.

Guess the Artifact: #10

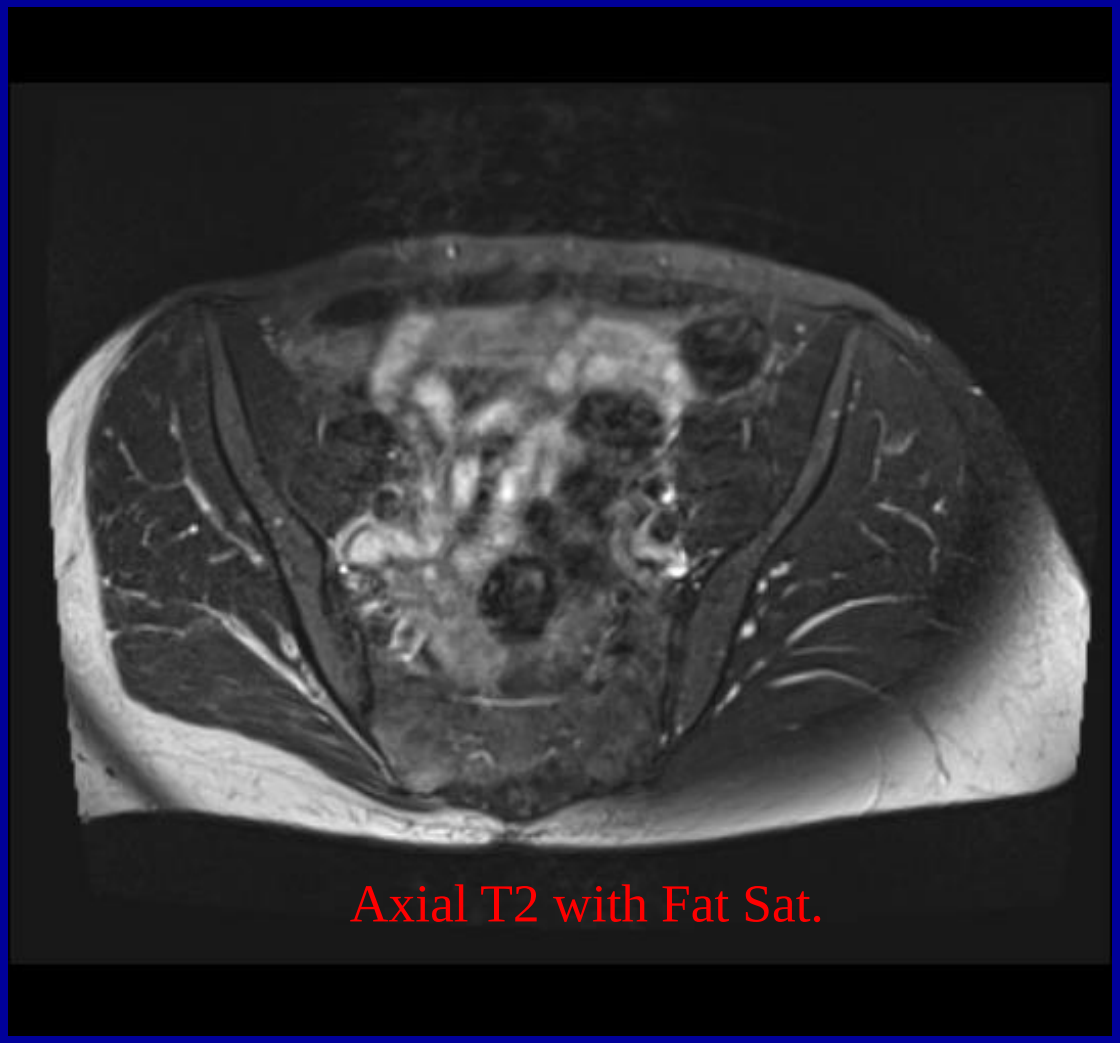
Where is it?

What is it?

How is it caused?

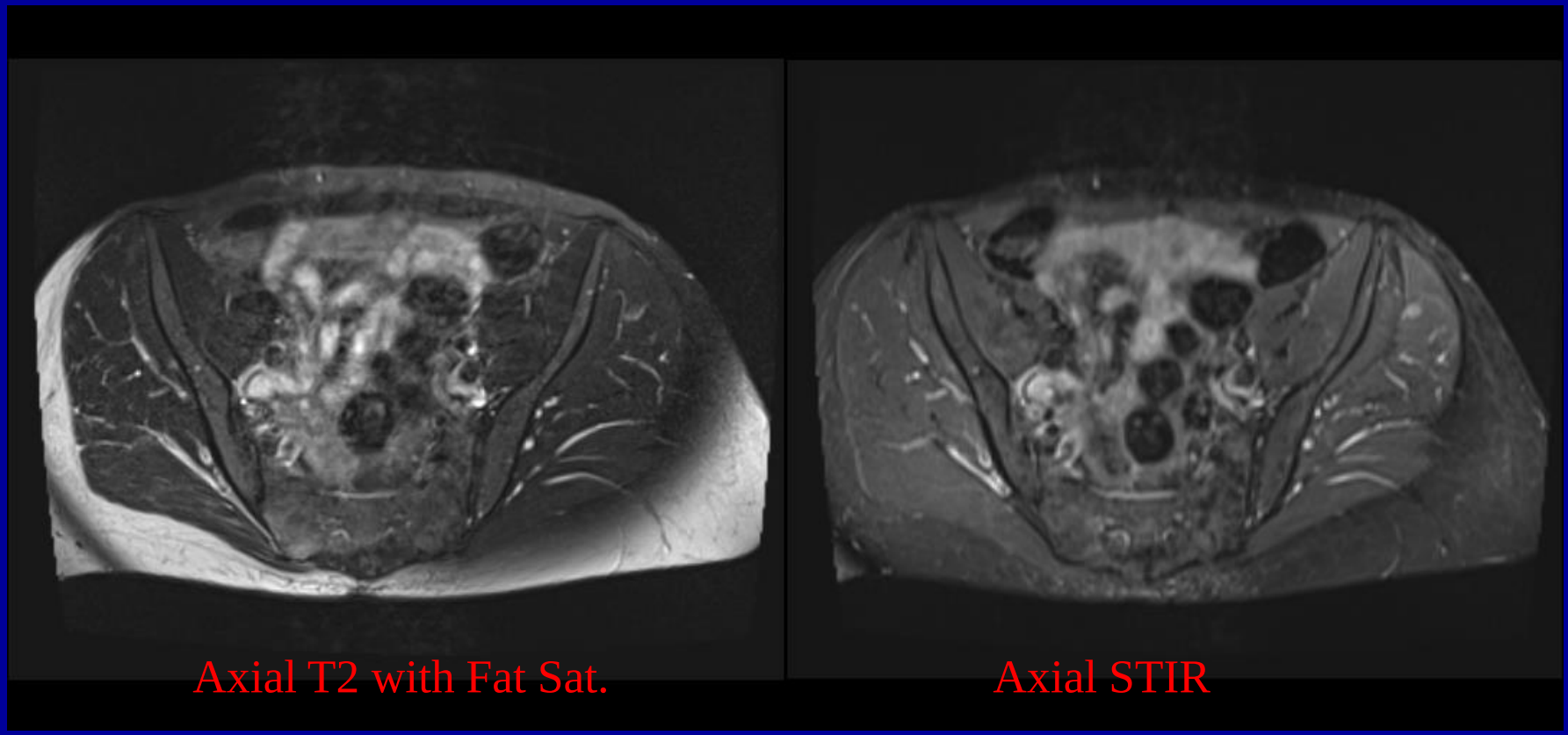
What can you do about it?

Guess the Artifact: #10



Axial T2 with Fat Sat.

Guess the Artifact: #10



Axial T2 with Fat Sat.

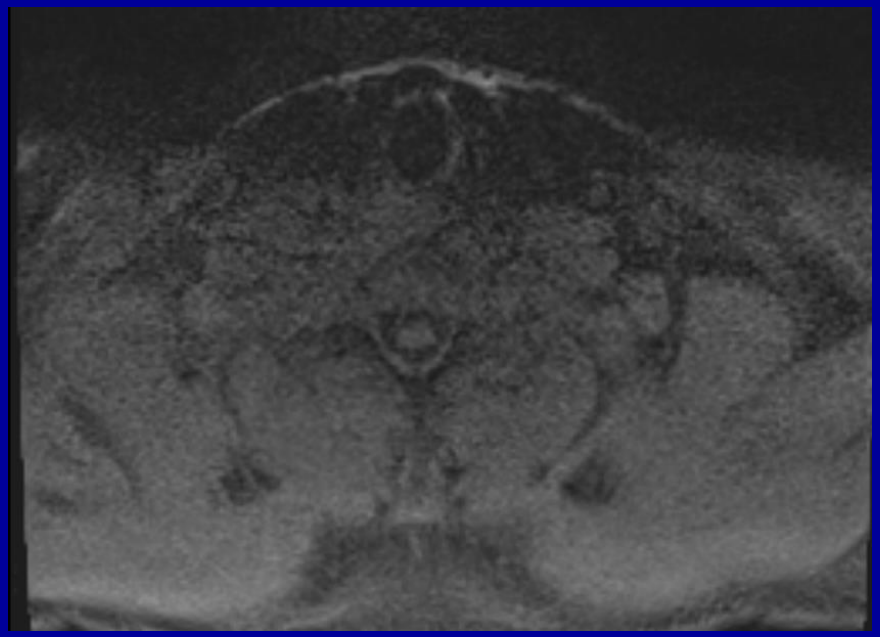
Axial STIR

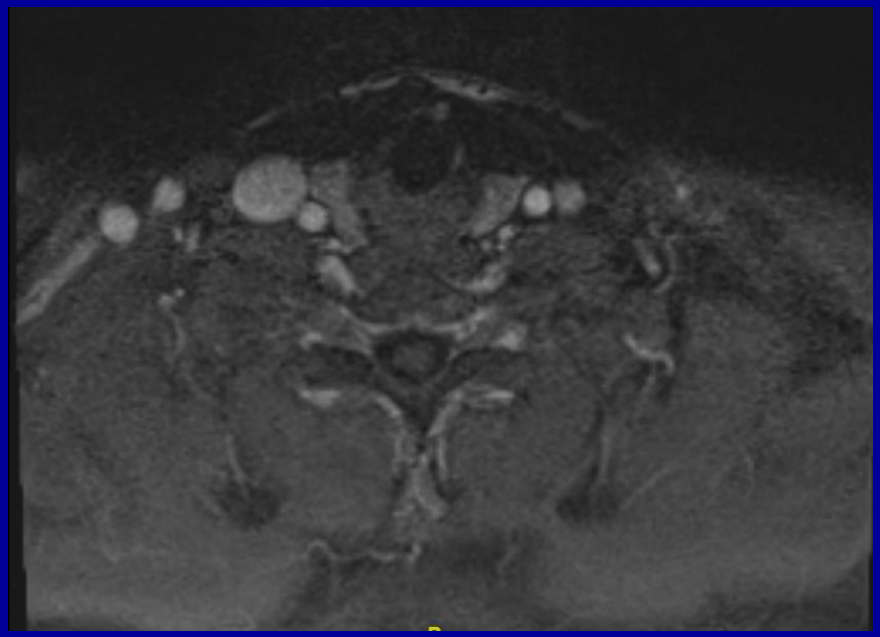
10. Incomplete fat suppression

- Often caused by inhomogeneous Bo field degrading spectral-based fat-saturation techniques (e.g. frequency-selective RF pulses)

- Solutions:
  - (1) Try to improve the shim.
  - (2) Try different fat suppression techniques: STIR, Dixon – these are based on T1 and chemical shift and are not sensitive to Bo inhomogeneity.
    - What are some disadvantages of STIR?

Another example of Improper fat suppression





- Degradation of spectral-based fat-saturation techniques (e.g. frequency-selective RF pulses) giving water rather than fat saturation in some regions.

Guess the Artifact: #11

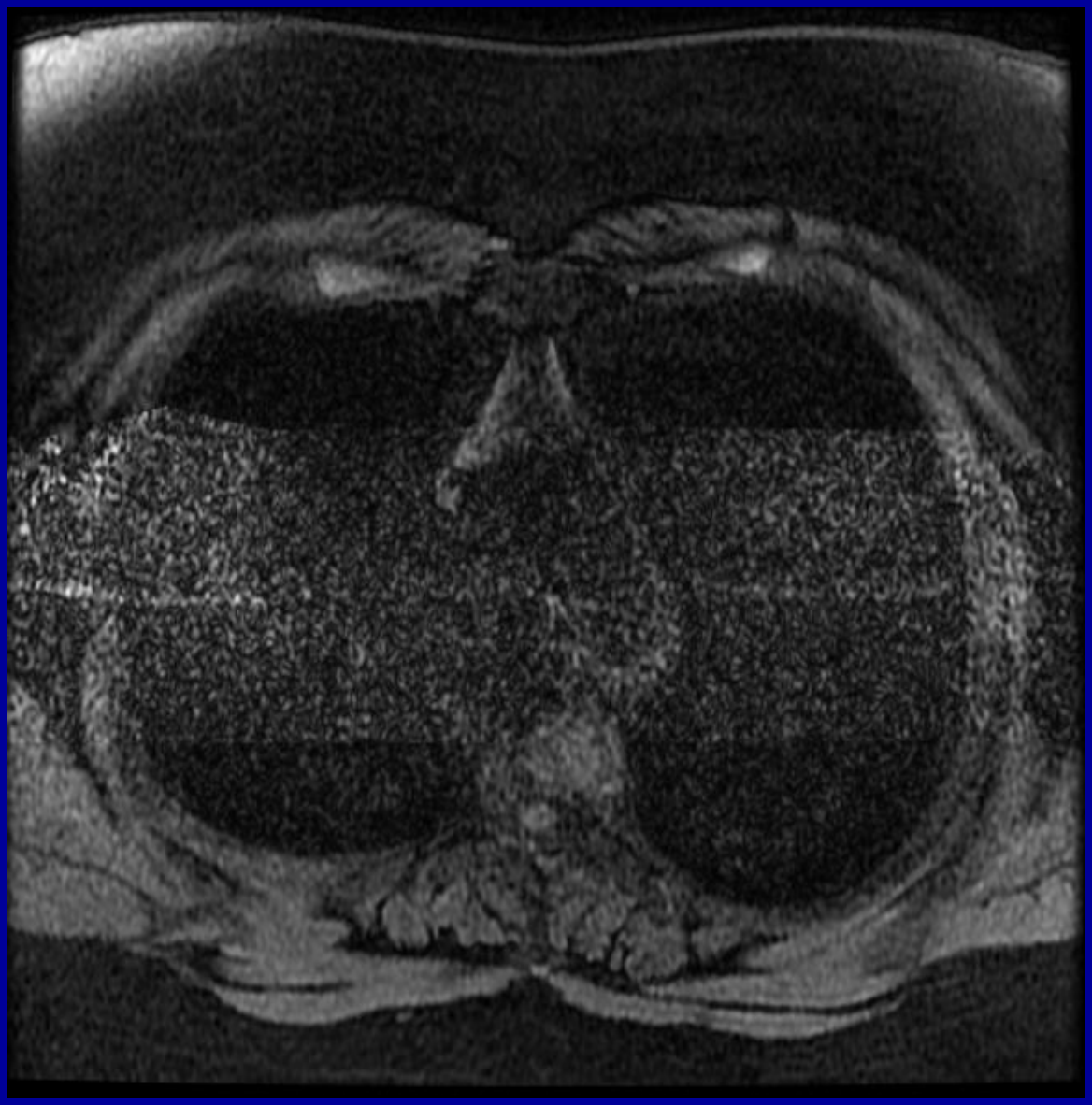
Where is it?

What is it?

How is it caused?

What can you do about it?

Guess the Artifact: #11



11. Parallel imaging artifact

- Often caused by failure in reconstruction. Parallel imaging requires a good reference and when not obtained can give artifact that appears as a band of noise. Tip- often near the center of the image.

- Solutions:
  - Redo the reference scan.
  - Change the acceleration factor.

Guess the Artifact: #12

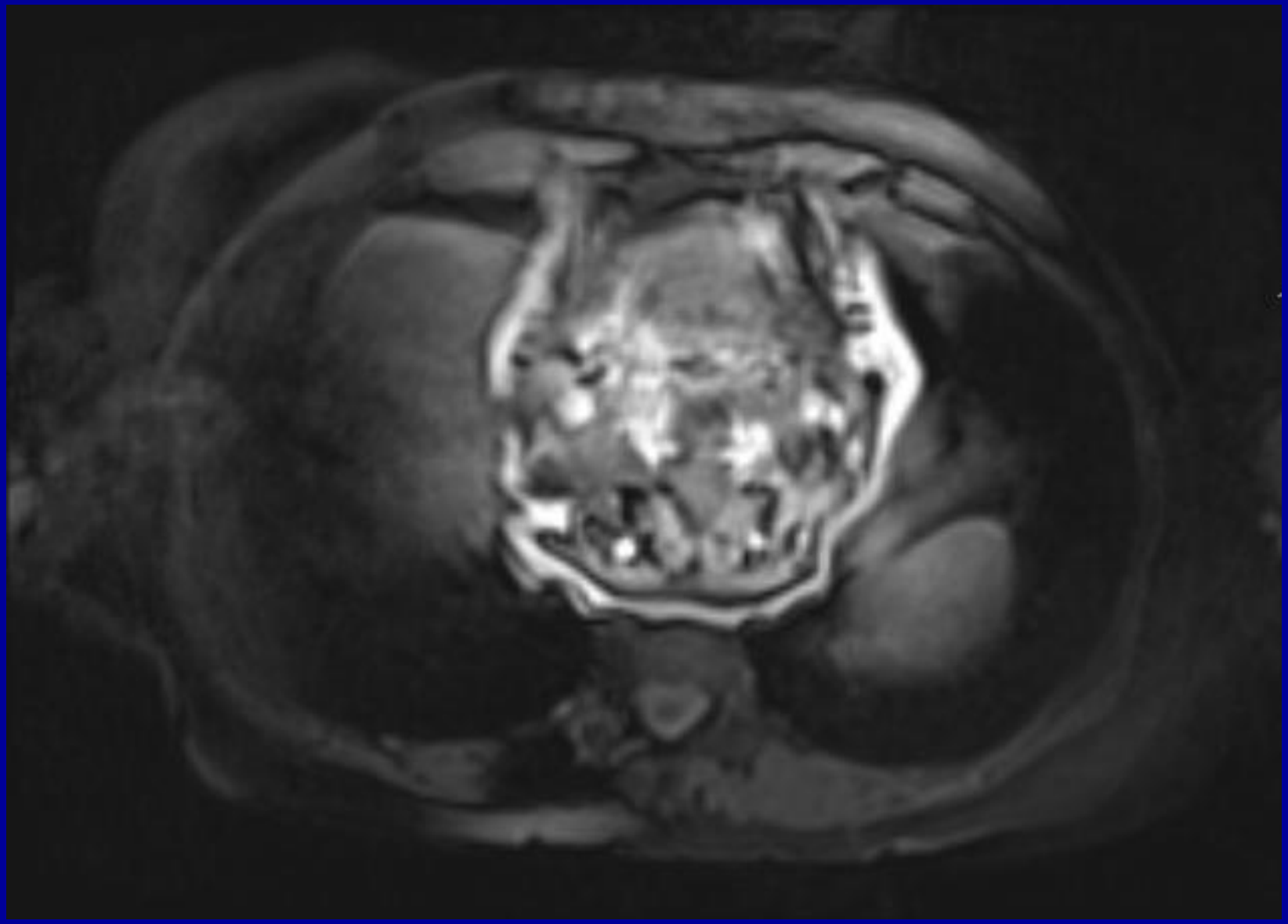
Where is it?

What is it?

How is it caused?

What can you do about it?

Guess the Artifact: #12



12. 3D Phase Wrap in slice direction

- Caused by wrapping (or aliasing) of one side of the 3D FOV in the slice direction to the other side. Appears like superimposition of signals of different slices.
- Solutions: Increase the FOV, saturate signal at the edge of the FOV.

Guess the Artifact: #13

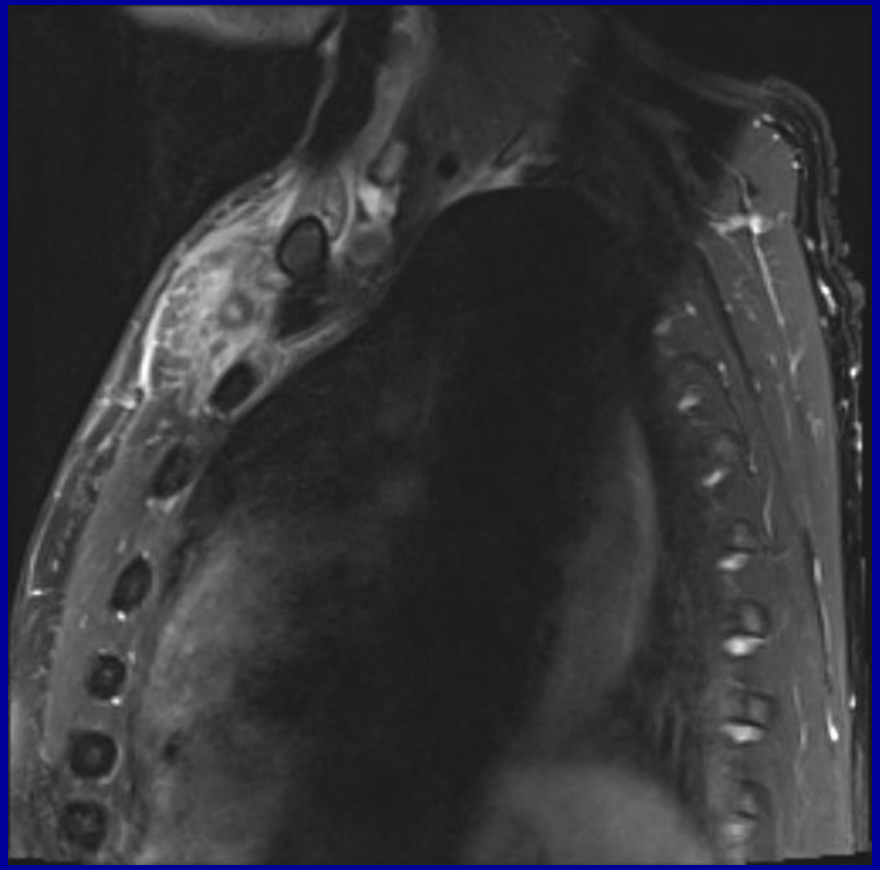
Where is it?

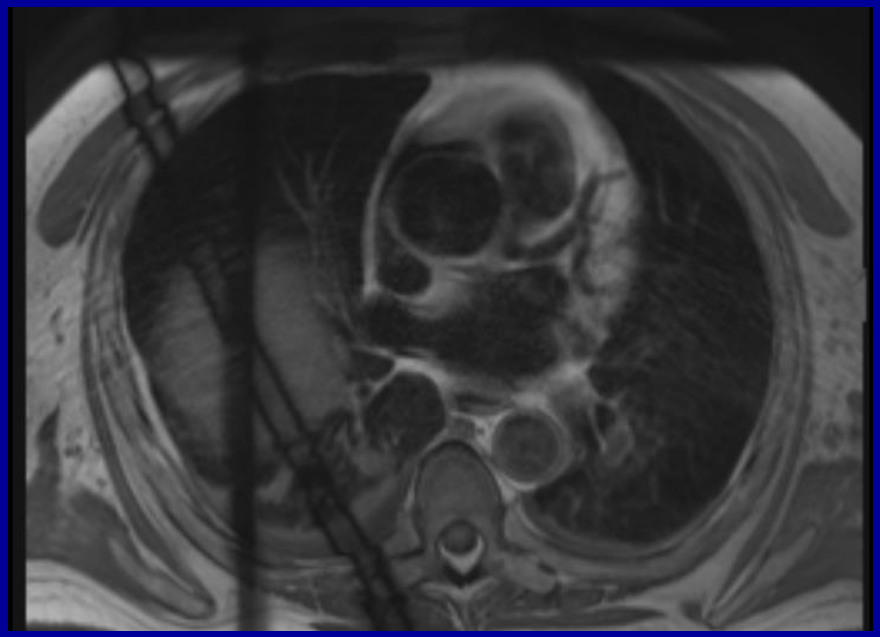
What is it?

How is it caused?

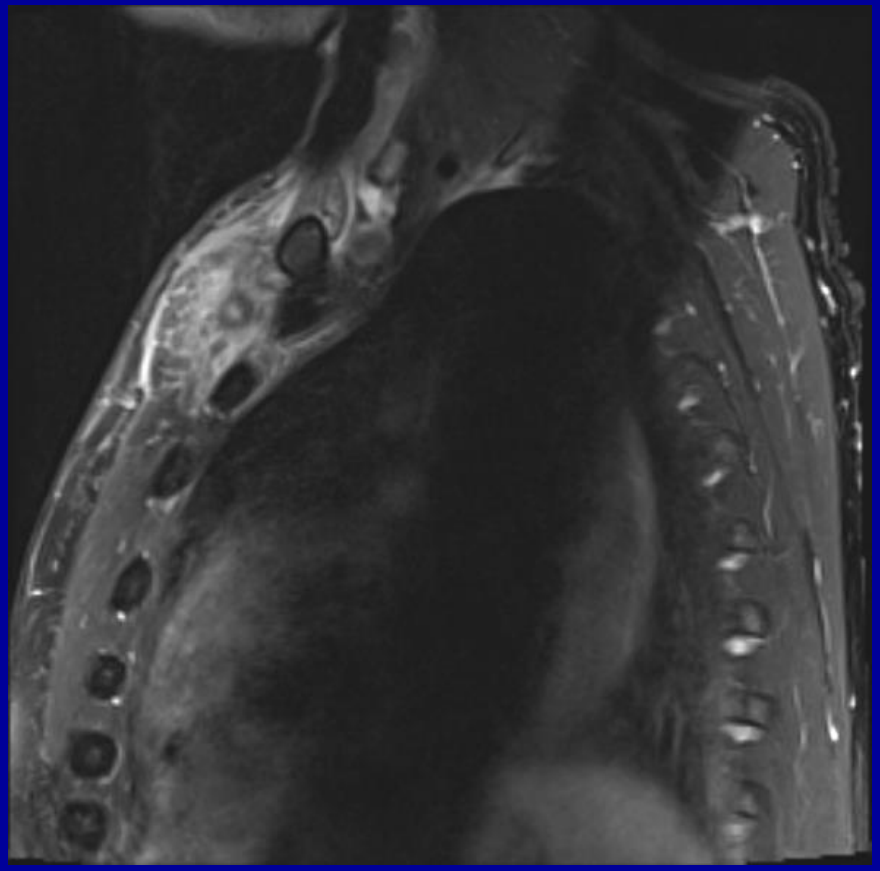
What can you do about it?

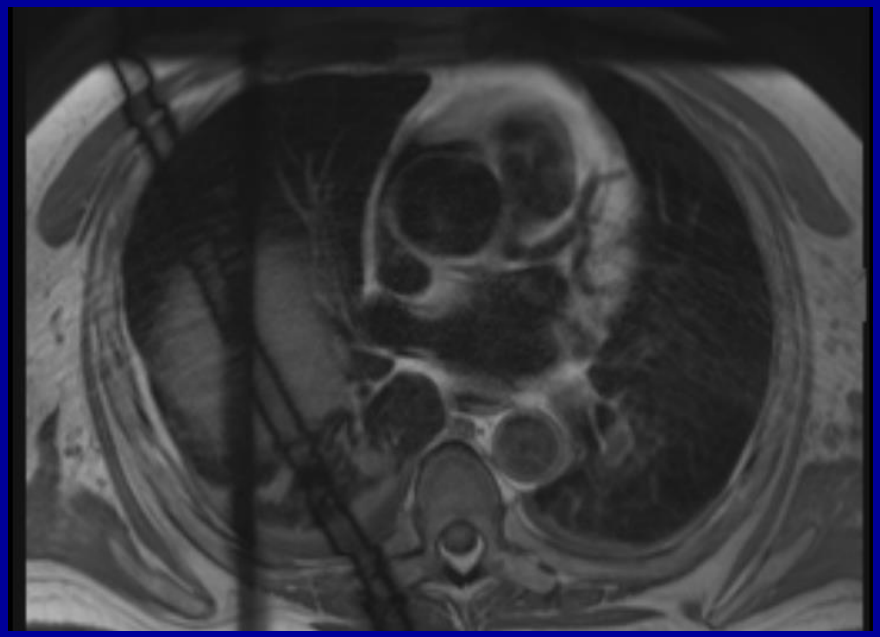
Guess the Artifact: #13





Guess the Artifact: #13



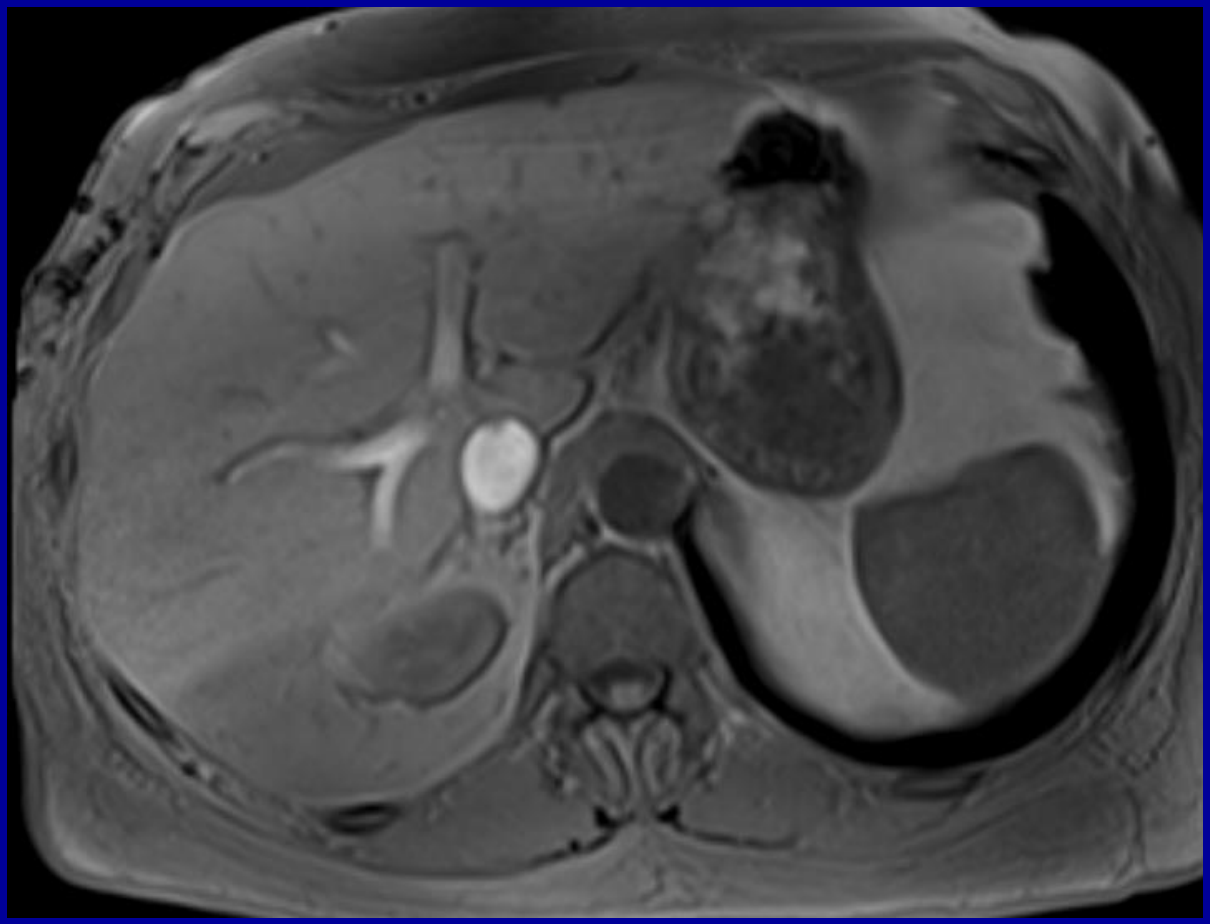


Black bands: Artifact or feature?

13. Saturation bands

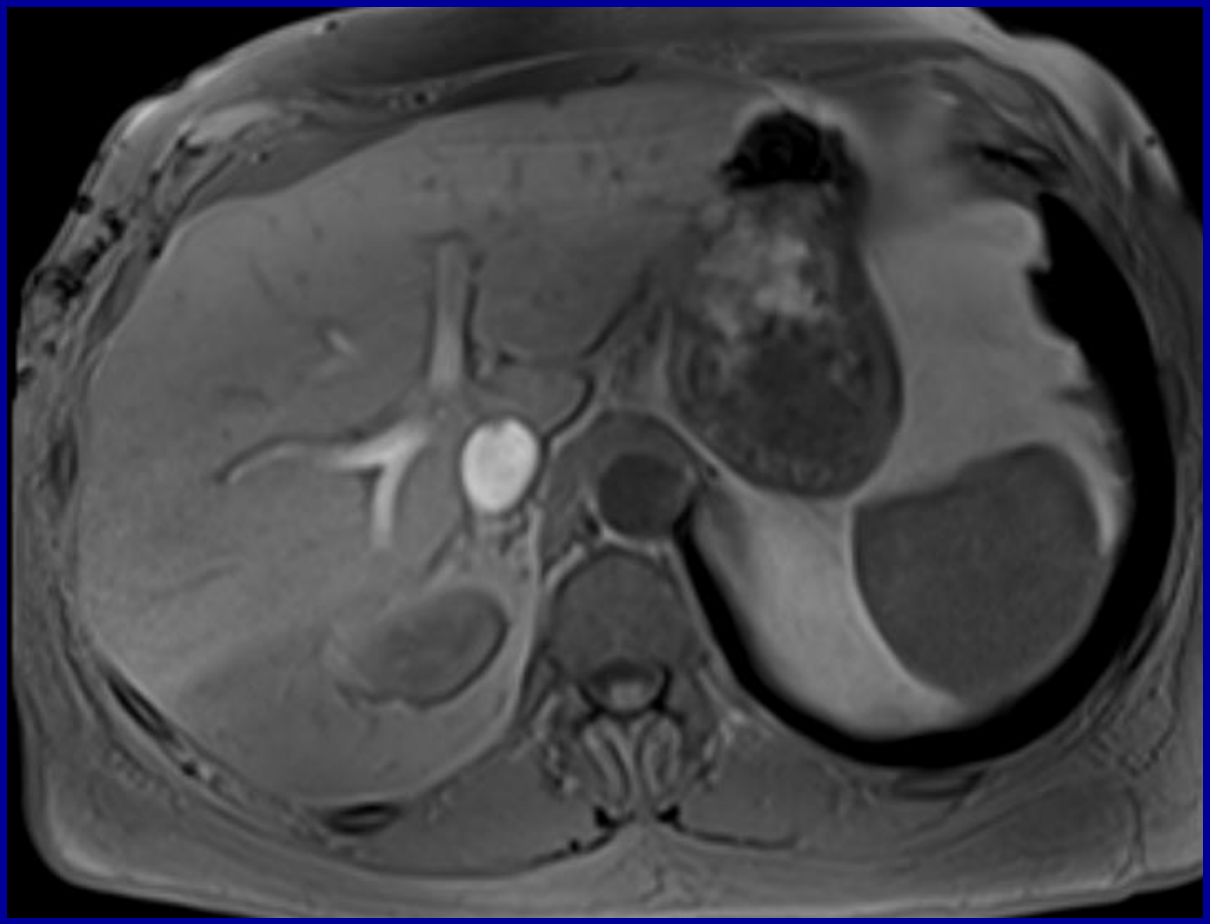
- Saturation bands may be used to purposefully remove signal from a particular part of the body
  - Typically done to remove motion artifact when imaging a stationary structure near a moving structure
    - E.g. heart or lungs in spine imaging
- Saturation bands may also be seen as a consequence of special imaging techniques such as
  - Respiratory navigation – repeated imaging of the diaphragm saturates those protons
  - Grid tagging

Guess the Artifact: #14



(look at the vessels)

14. Inflow enhancement



Unsaturated blood flows into selected volume resulting in unintended signal enhancement (see portal vein and IVC).