The MRI CCSVI Protocol: What to do and what to expect

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Acknowledgements

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- Zahid Latif
- Yashwanth Katkuri

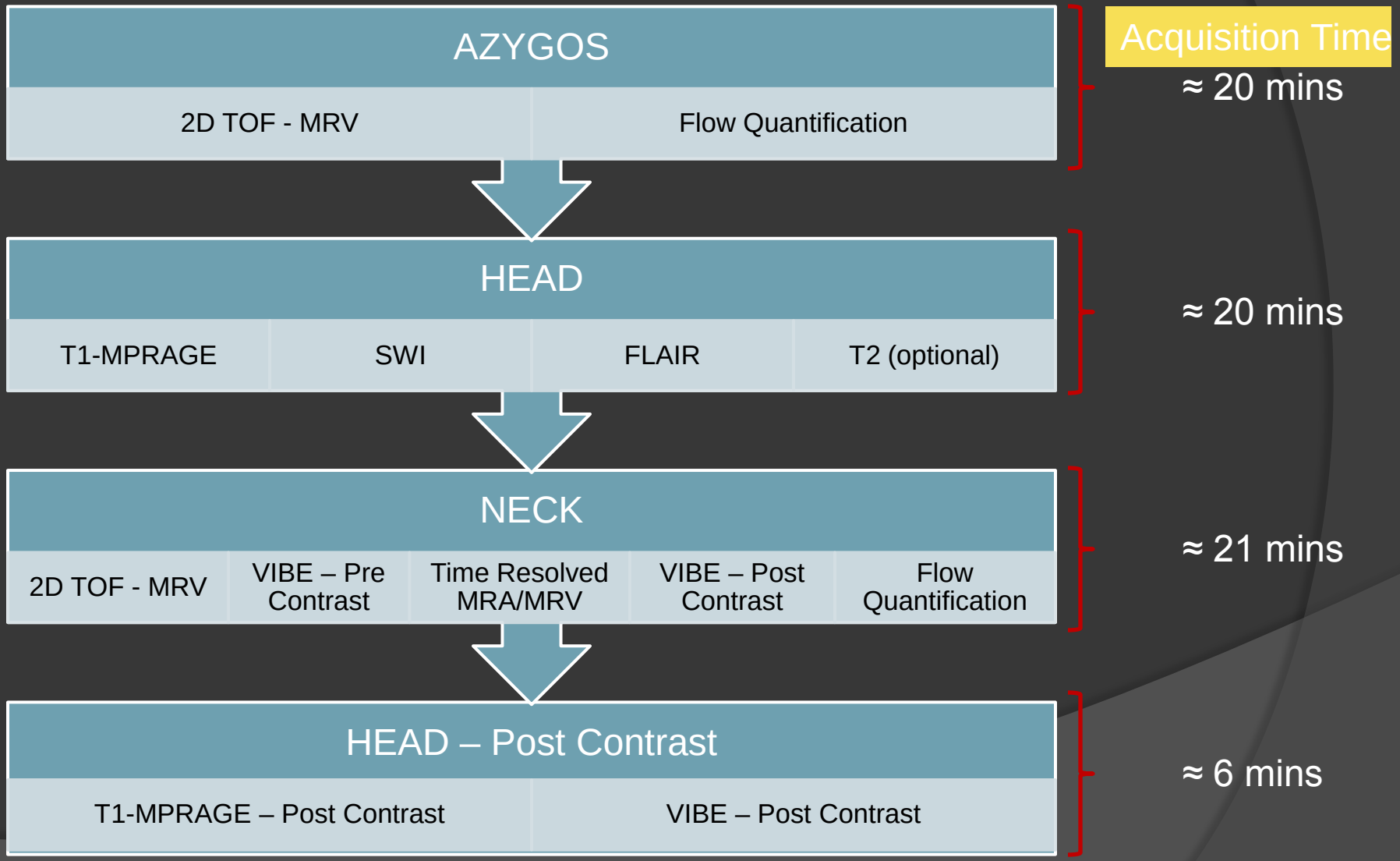
Goal

- To collect anatomic data for the veins and arteries in the head, neck and upper chest.
- To quantify flow and flow patterns.
- To evaluate iron content in the brain using Susceptibility Weighted Imaging (SWI).

MR Imaging Techniques

- 3D Techniques:
  - (SWI) Susceptibility Weighted Imaging
  - (FLAIR) Fluid Attenuated Inversion Recovery
  - (MPRAGE) Magnetization Prepared Rapid Acquisition Gradient Echo
  - (VIBE)Volume Interpolated GRE
  - MRA/MRV Time Resolved
- 2D Techniques:
  - MRV Time of Flight
  - FLOW QUANTIFICATION - Phase Contrast

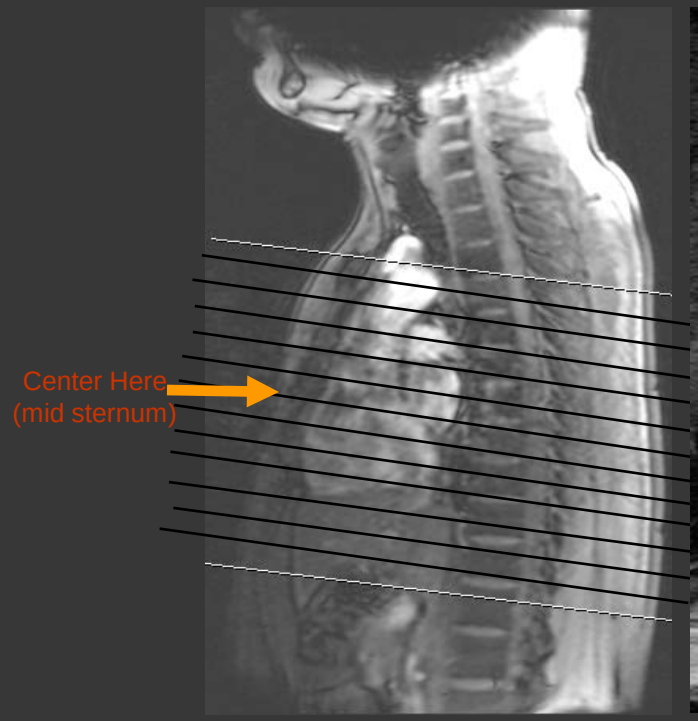
Acquisition of the CCSVI Protocol



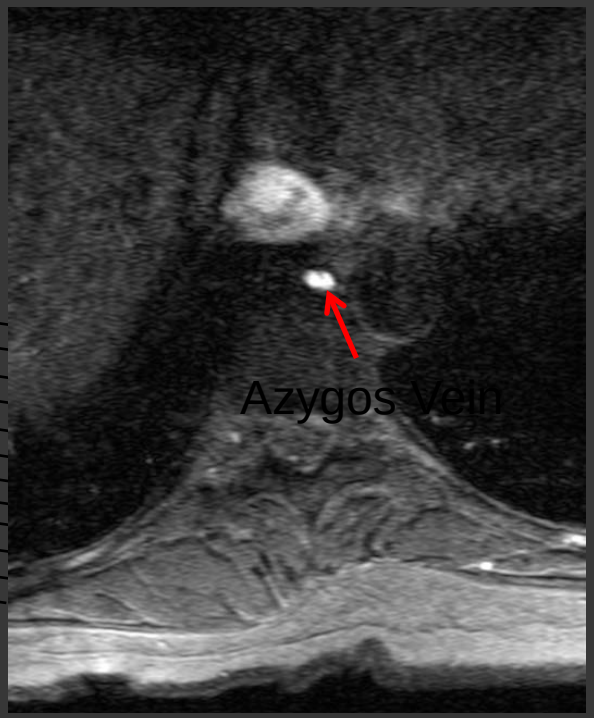
Imaging Azygos Vein

- Register the subject with their height and weight.
- The study starts with imaging of Azygos vein and it takes approximately 20 minutes to run all the sequences required for imaging for the azygos. This allows us to provide a break for the subject, if needed.
- Activate NE1,2; SP1,2,3,4 coils.
- For flow quantification, make sure the pulse trigger on the subject's (left / right) index finger and use venc = 50 cm/sec.

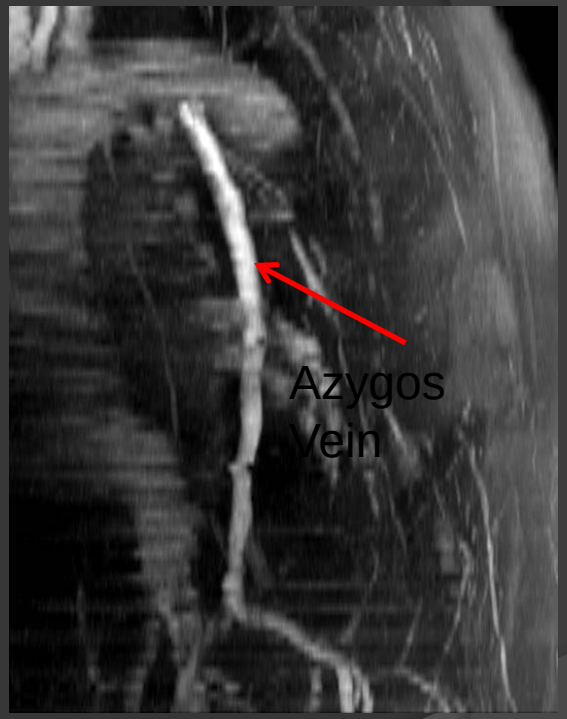
2D MRV (azygos) - Axial



Slice position

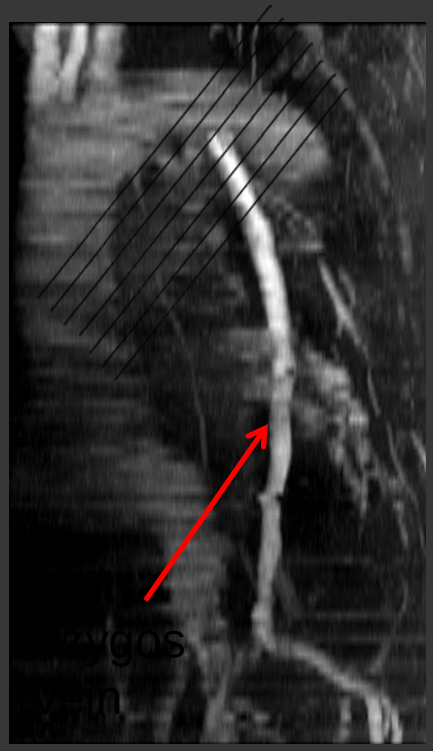


An example image showing azygos in axial plane

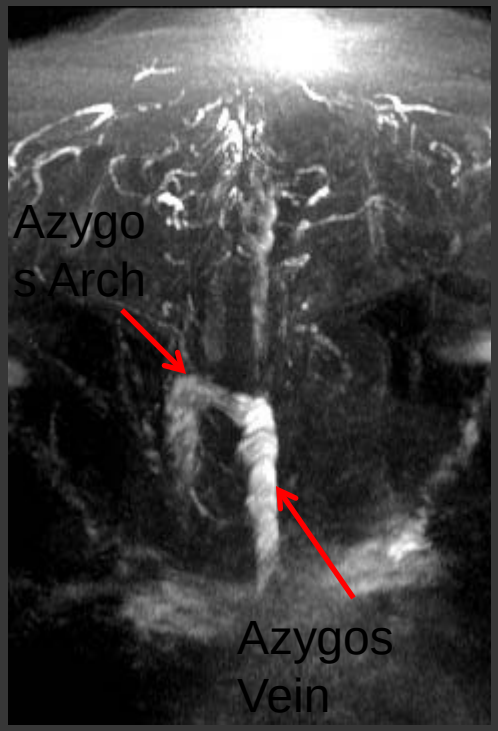


An example image showing the MIPed sagittal slice

2D MRV (azygos arch) - Axial



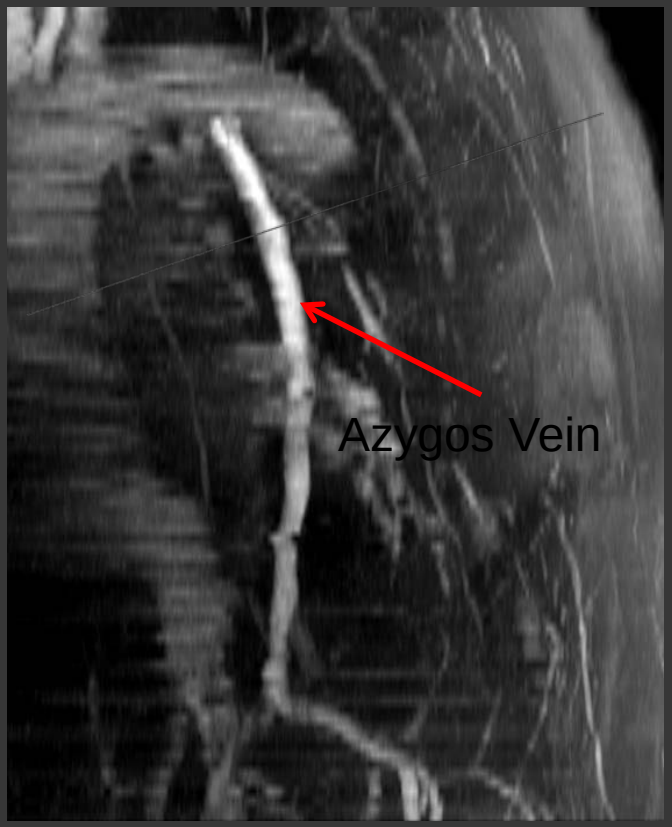
Slice position



An example of azygos arch – MIPed image in coronal plane

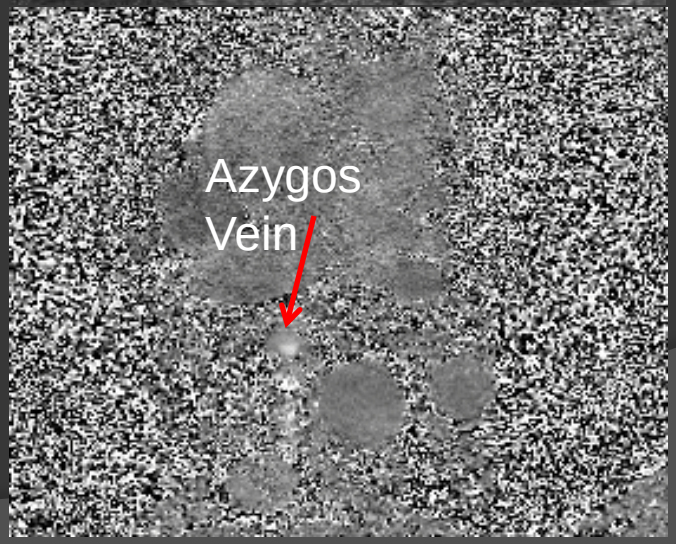
An example of azygos arch – MIPed image in sagittal plane

Flow Quantification – Azygus vein



Slice position

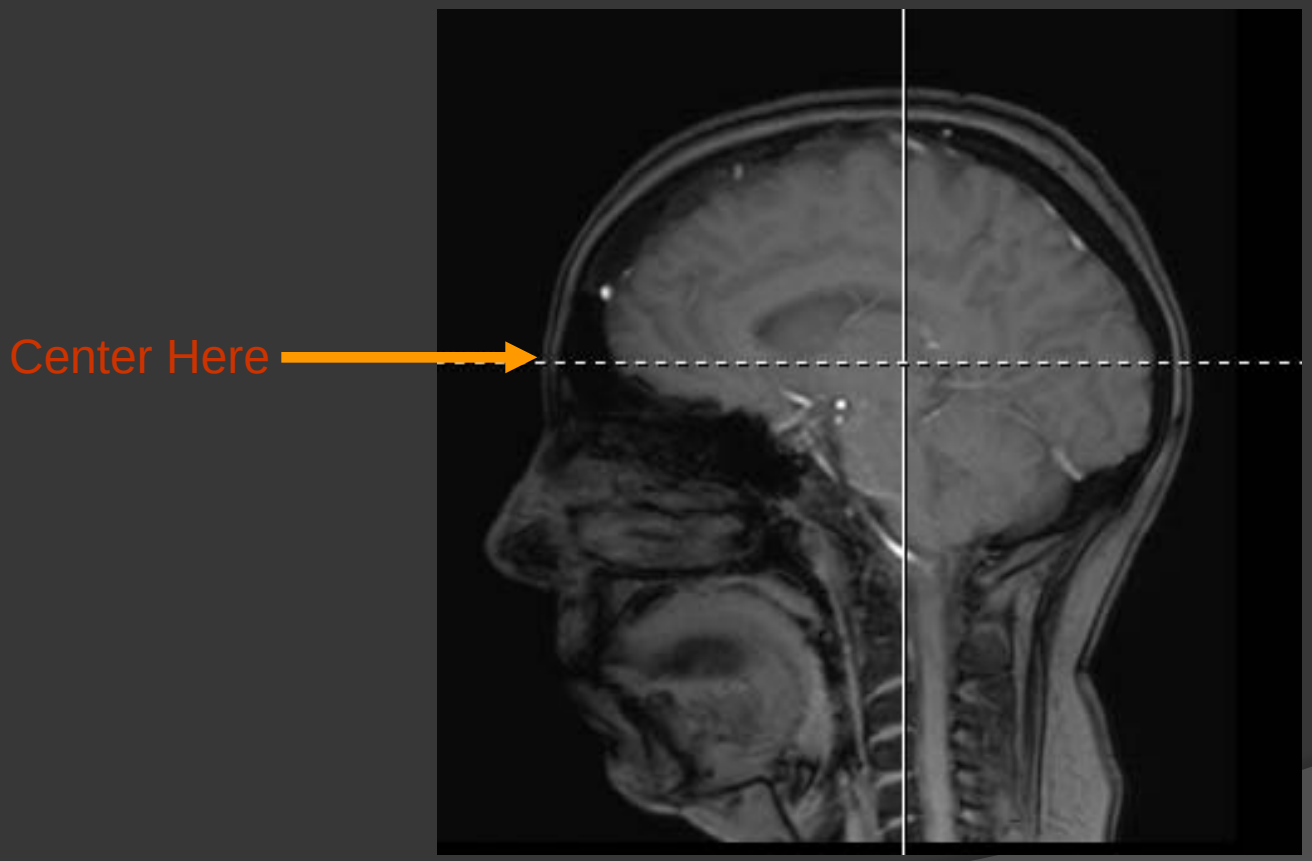
An example showing the flow quantification magnitude image



An example showing the flow quantification phase image

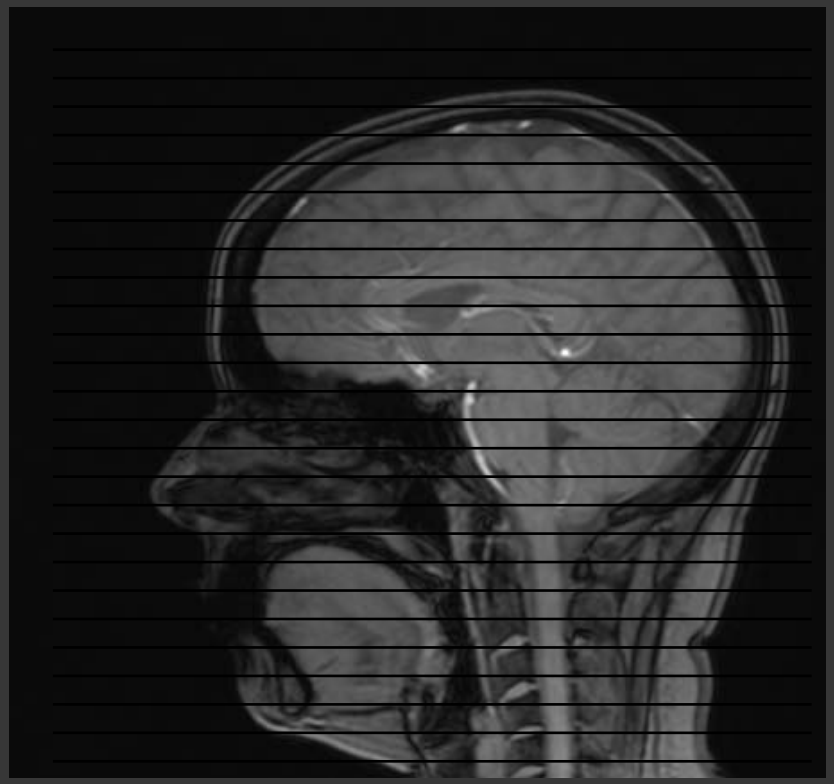
Imaging the Head

- Move the table position to center at the orbital ridge.
- Activate HEA; HEP coils.



Head Localizer

MPRAGE (Pre Contrast) –T1 Axial

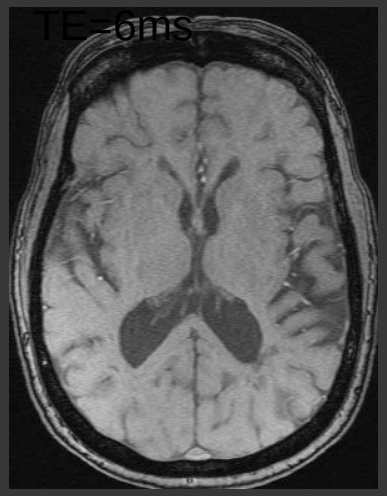


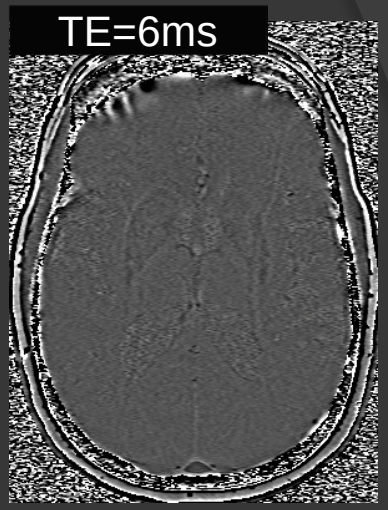
Slice position

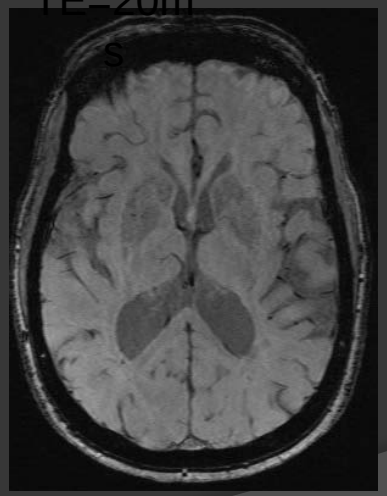
An example showing the T1-MPRAGE image in axial plane

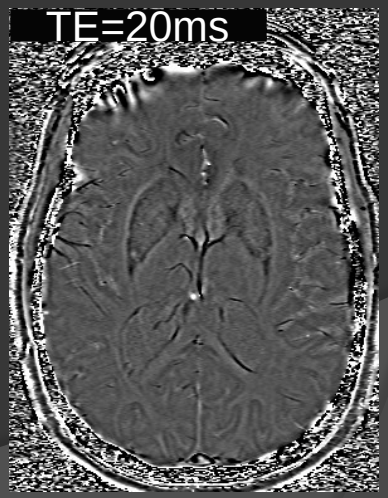
Dual Echo SWI 1mm x0.5mm x 2mm, TE=6ms and 20ms – Axial

Slice position





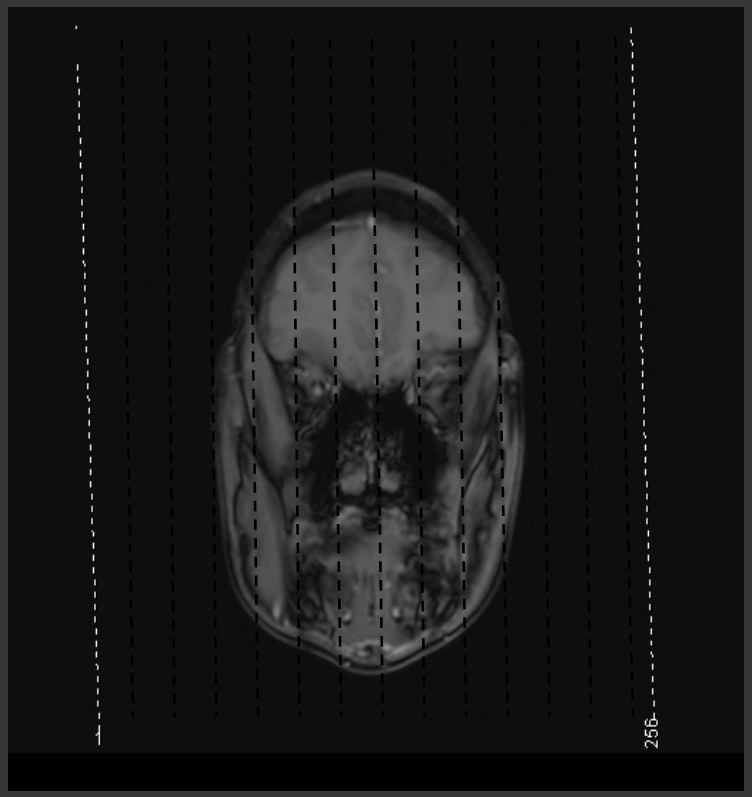




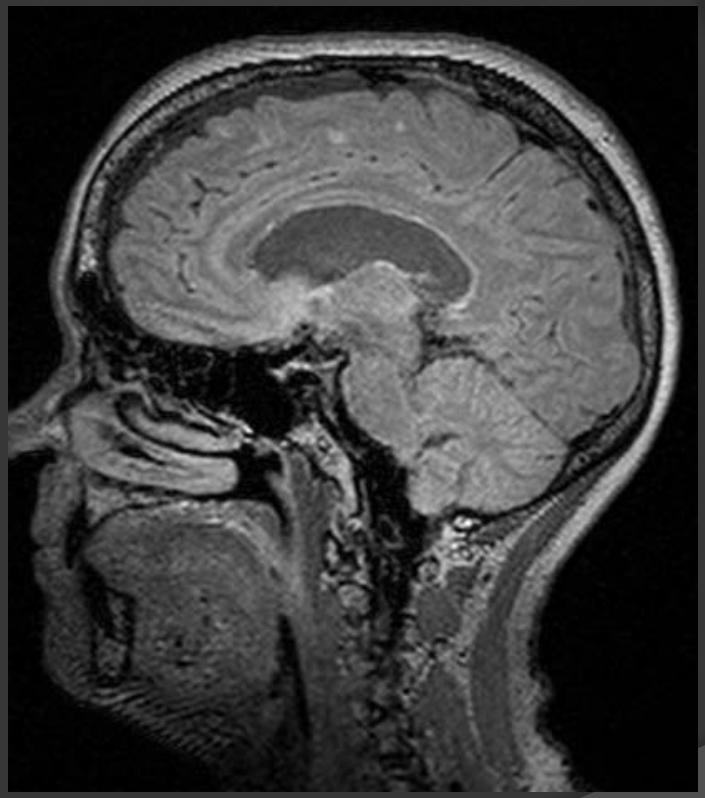
An example showing SWI - magnitude and phase images

NOTE: If dual echo SWI is not possible at your center, run the sequence with a single echo TE = 20ms.

3D FLAIR - Sagittal

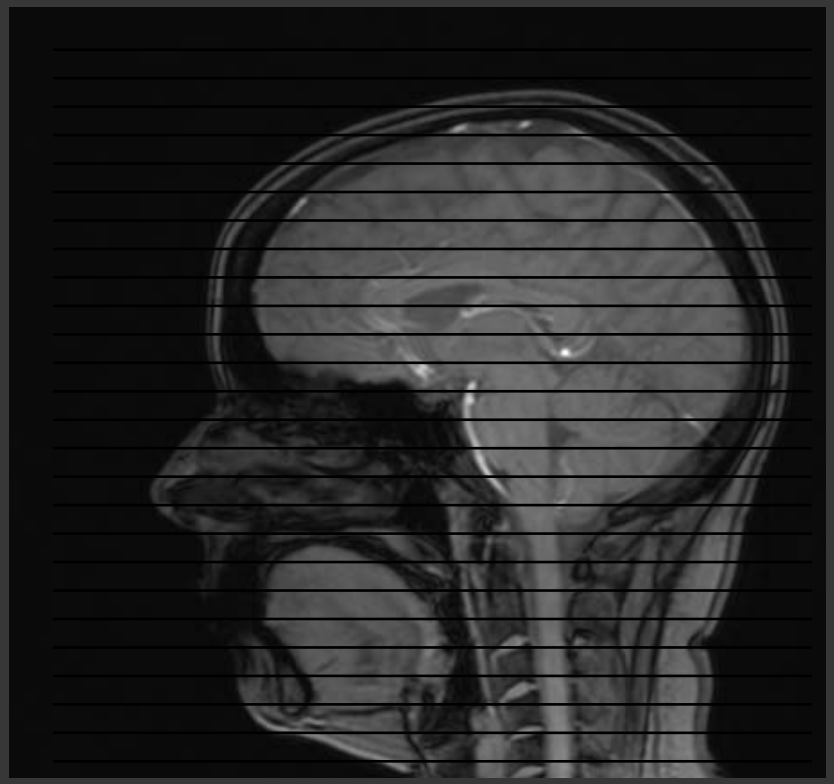


Slice position



An example showing the FLAIR image in sagittal plane

T2 Axial



Slice position

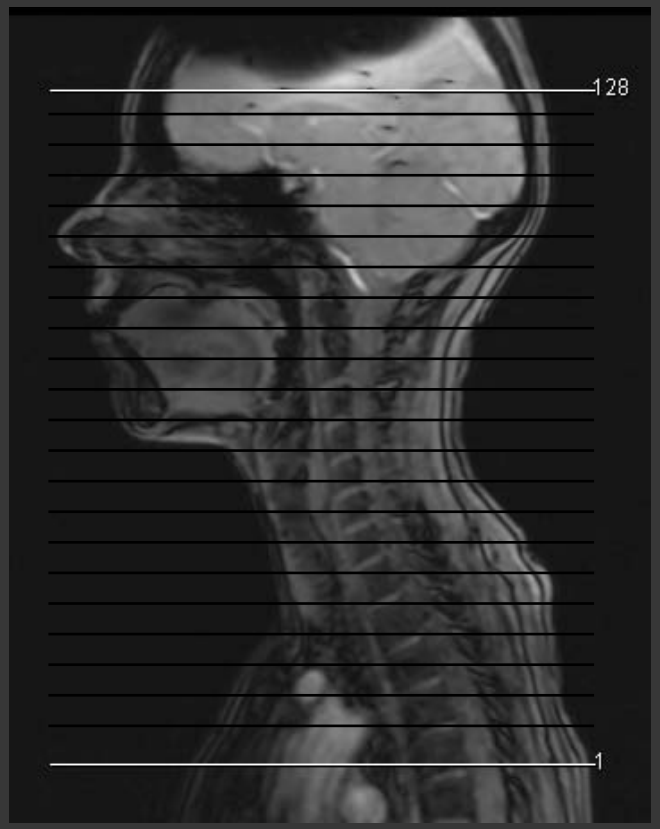
An example showing the T2 image in axial plane

Imaging Neck

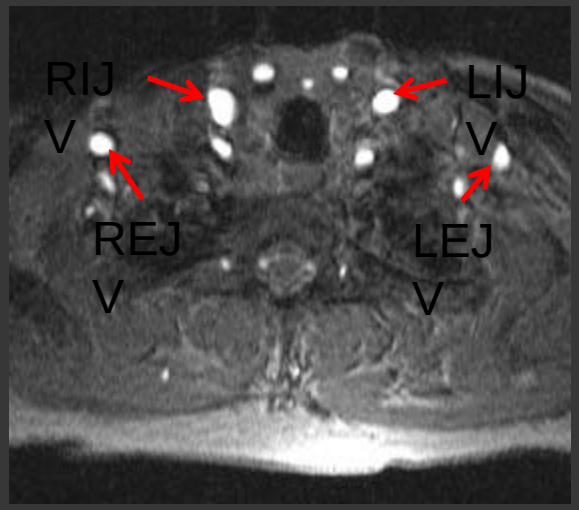
- Move the table position to center at the chin.
- Activate HEA; HEP; NE1,2; SP1,2 coils

Neck Localizer

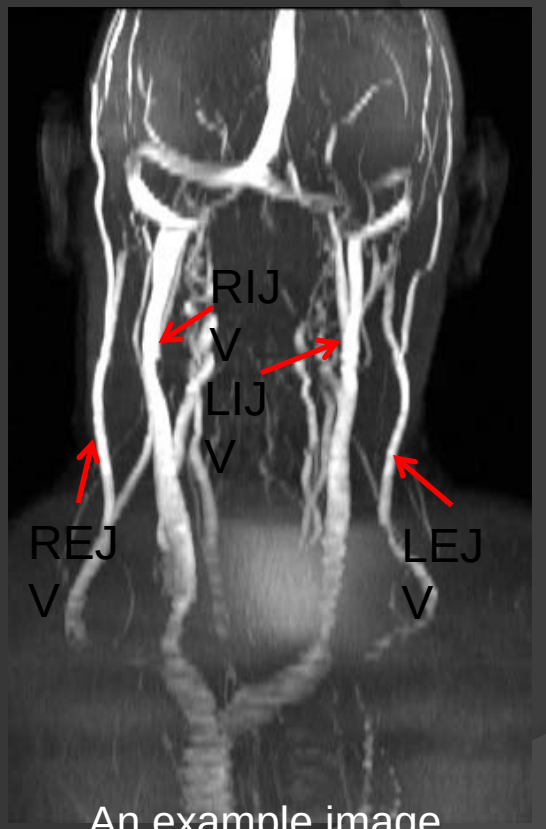
2D MRV (neck) - Axial



Slice position



An example image showing IJV's, EJV's in axial plane

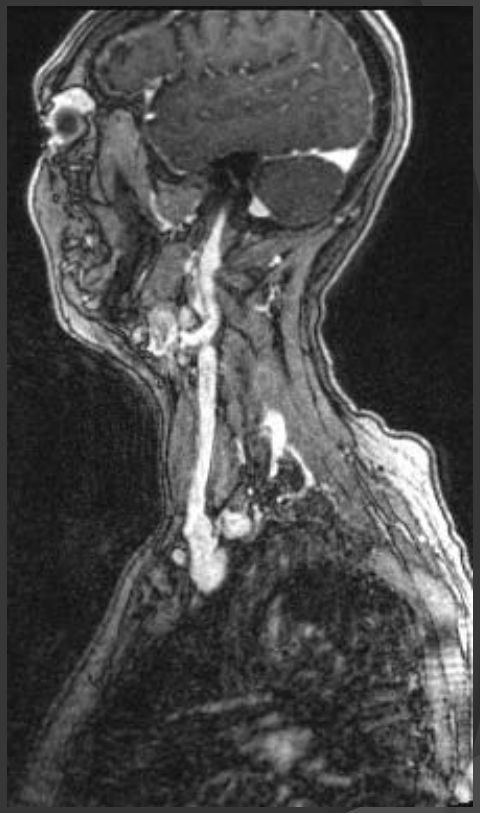


An example image showing the MIPed coronal slice

3D VIBE (Pre/ Post Contrast) - Sagittal

Slice position

An example image showing **pre-contrast vibe** in sagittal plane



An example image showing **post-contrast vibe** in sagittal plane

3D MRA / MRV (Dynamic) - Coronal

Slice position

An example image showing the MIPed coronal slice – **Arterial Phase**

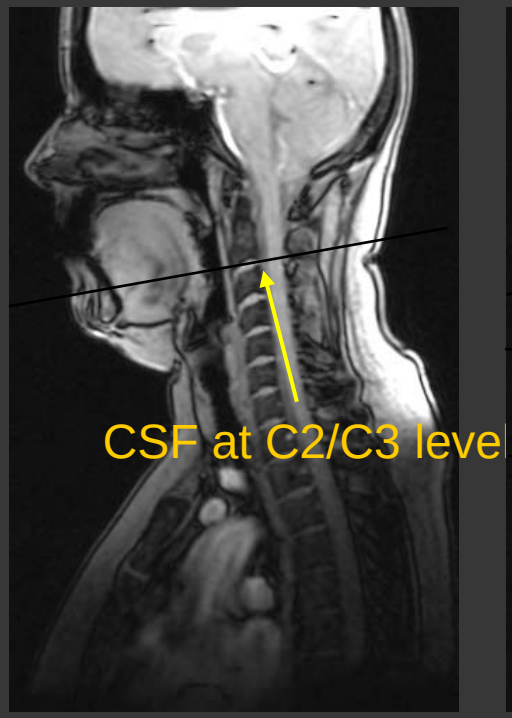
An example image showing the MIPed coronal slice – **Venous Phase**

Note:

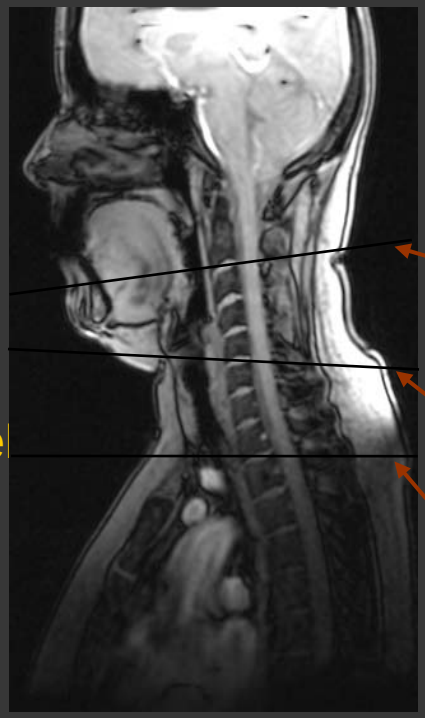
- Use the MIPed sagittal slice from the 2D MRV sequence and position the slice slab parallel to the Jugular veins to acquire 3D MRA/MRV.
- Start the contrast Injection on 3rd time point of 20 measurements.
- Normal Contrast dose = 0.1 mmol/kg, Injection rate = 2 cc/sec

Imaging the Neck – Flow Quantification

FQ – CSF Flow



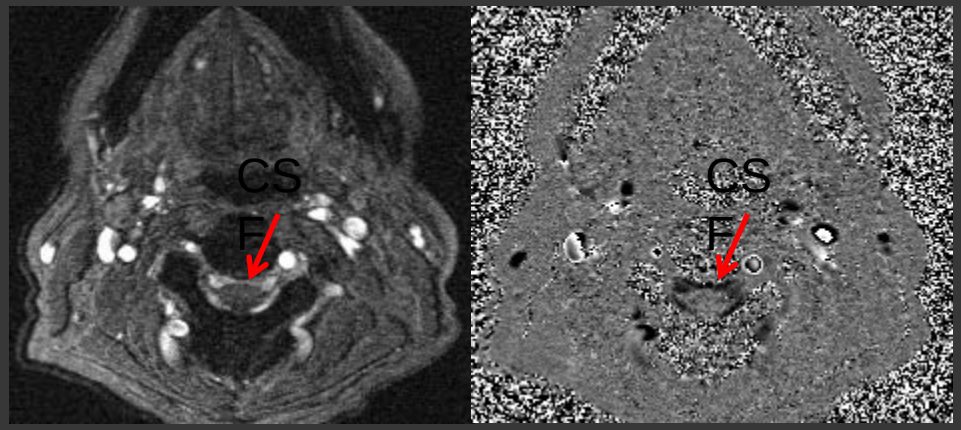
FQ – Internal Jugular veins



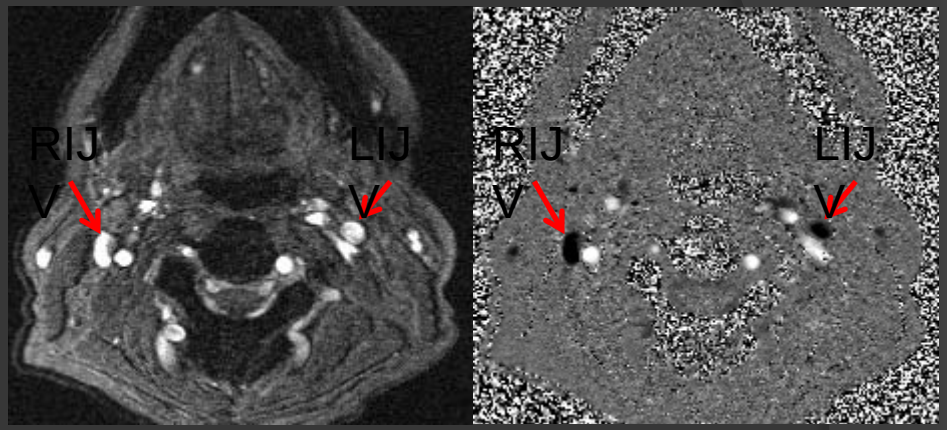
Note:

- Activate appropriate coils .
- Make sure pulse trigger is on the subject's (left / right) index finger.
- Position the slice perpendicular to CSF flow at C2/C3 neck level and use venc = 15 cm/sec.
- Position the slice slab perpendicular to the Internal Jugular vein at C2/C3, C5/C6 and T1/ T2 neck levels. Run this sequence at three positions as shown above and use venc = 50 cm/sec.

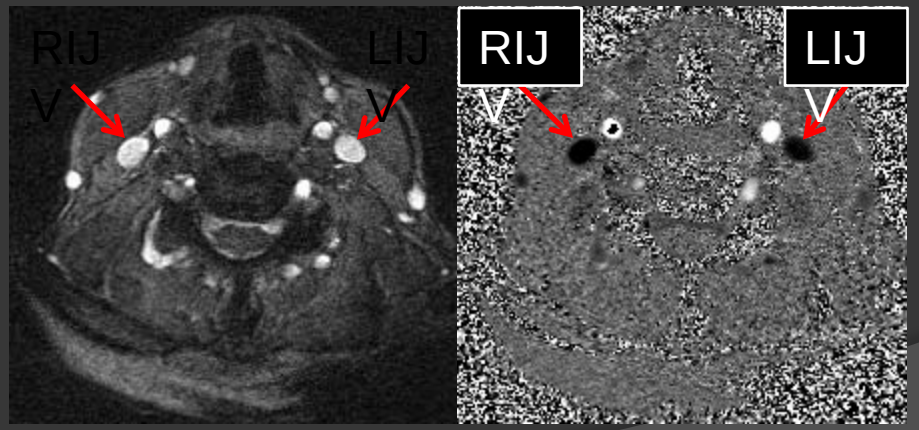
Example images on Flow Quantification



An example showing CSF at C2-C3 neck level

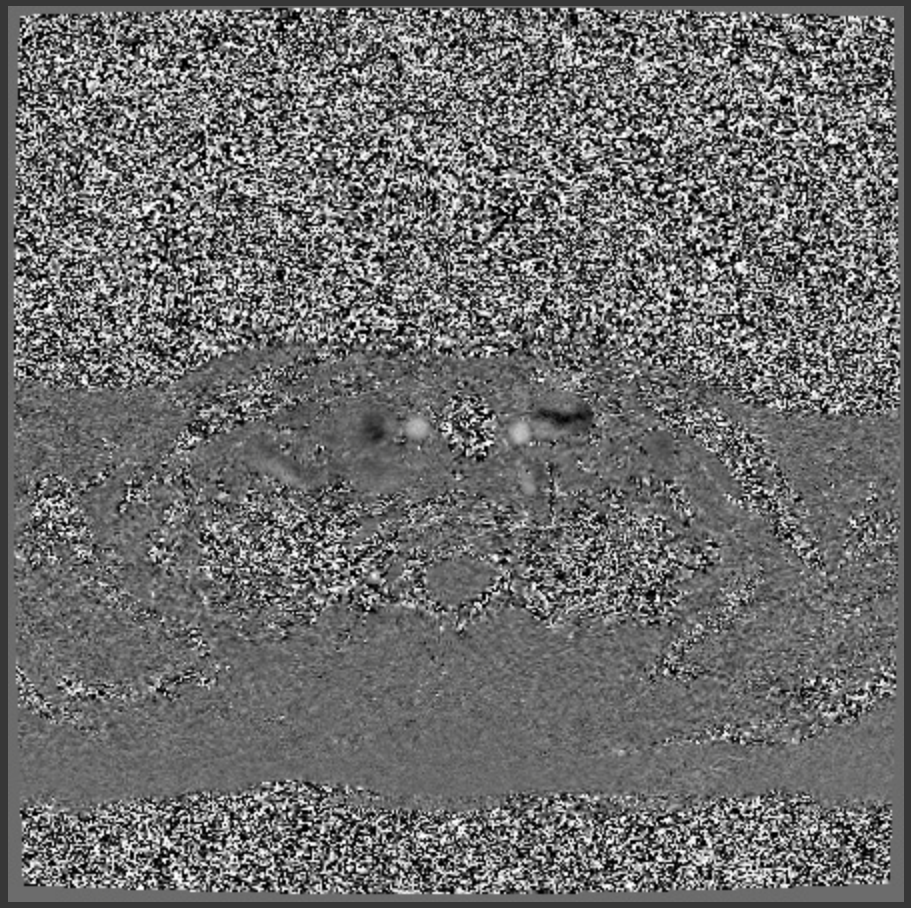


An example showing the IJV's at C2-C3 neck level



An example showing the IJV's at C5-C6 neck level

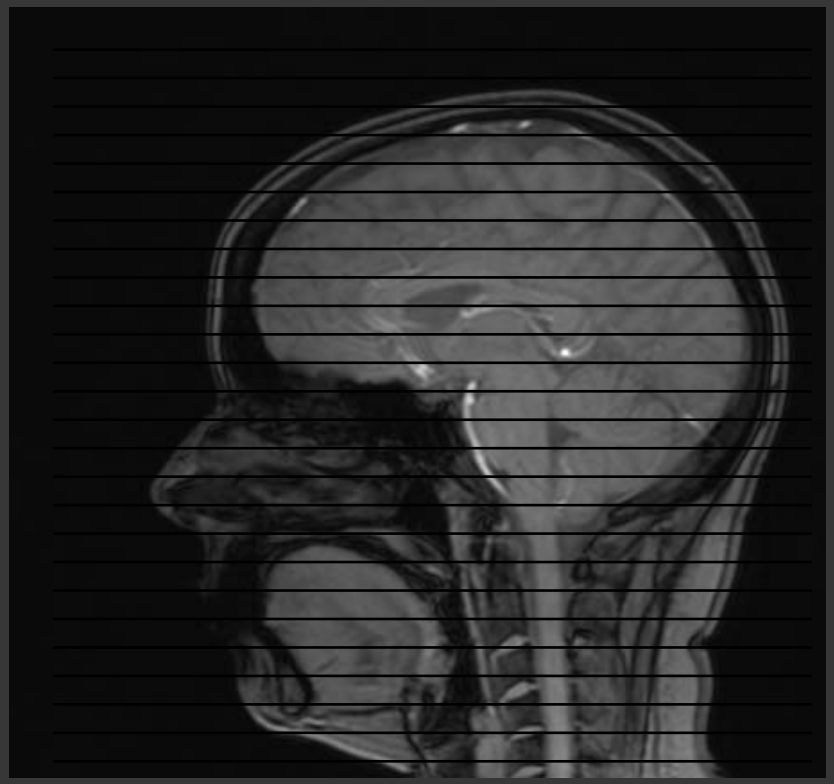
Example flow in the lower neck



Imaging the Head – Post Contrast

- Move the table position to center at the orbital ridge.
- Activate HEA; HEP coils.

MPRAGE (Post Contrast) –T1 Axial

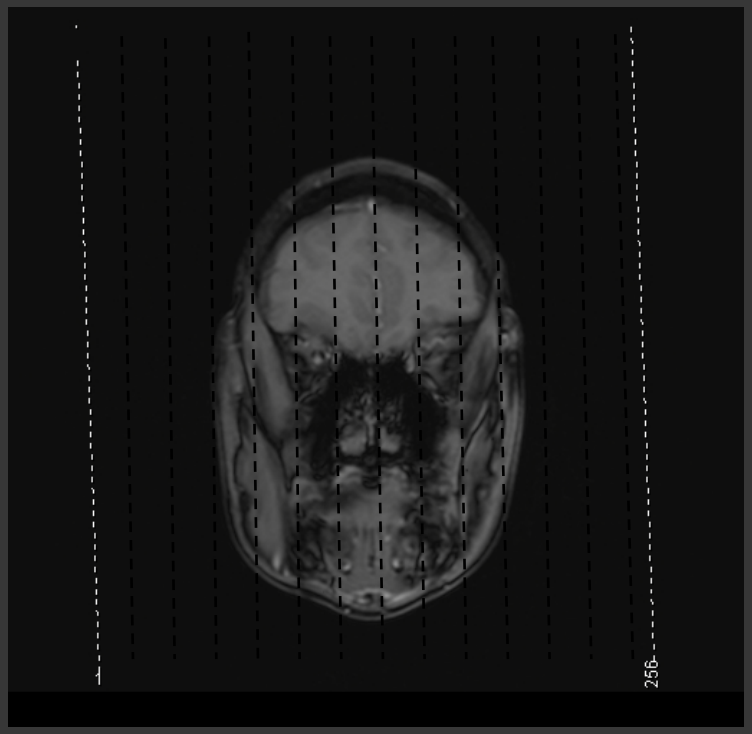


Slice position

An example showing the T1-MPRAGE image in axial plane

NOTE: For MPRAGE Post Contrast – please match with pre contrast.

3D VIBE (Post Contrast) - Sagittal



Slice position

An example image showing **post-contrast vibe** in sagittal plane

NOTE:
• For 3D VIBE Post Contrast - Copy the slice position from the 3D FLAIR sequence.

Protocol Access and Data Sharing

- For more information on resolution, fields-0f-view and other imaging parameters please visit:
- www.ms-mri.com/index.php?site=potential
- You can also download the Siemens 1.5T/3T protocols directly from this site. Protocols also available for GE.
- We welcome all collaborators to participate in the MS-NICE project (www.nice-mri.com/)
- By data sharing, we can amass 1000s of cases for future statistical analysis with a single protocol.