# NEURO MRI PROTOCOLS

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BRAIN

Brain 1 – Screen
- Indications
  - Screen, Altered mental status, Dementia, Psychiatric disorder, Headaches
- Sequences
  - Sag T1
  - Ax T1
  - Ax T2 FSE/TSE
  - Ax FLAIR FSE/TSE
  - Ax DWI / ADC / B0
  - Cor T2 FSE/TSE
- Comments
  - Axial scans should be parallel to the AC-PC line.
  - Add axial T1-MTC for suspected ALS.
  - For extrapyramidal disease use axial SE T2 instead of FSE.

Brain 2 – Brain – Tumor
- Indications
  - Tumor
- Sequences
  - Brain – Screen protocol
  - Ax T1 FS +C
  - Ax FLAIR +C
  - Cor T1 FS +C
- Optional
  - SPECT – Single Voxel
  - SPECT – Multi Voxel
- Comments
  - Add FLAIR post gad in suspected meningeal disease.
  - For brainstem and midline lesions get sagittal post gad instead of coronal.
  - For pineal lesions add thin sagittal T2 and T1 pre and post gad images.
  - Single voxel spectroscopy (TE 35 and 144) on all new mass lesions
  - Multi voxel only on suspected gliomas. For follow-up use TE 144.

Brain 3 – Brain – Infection / Meningitis
- Indications
  - Infection, Meningitis
- Sequences
  - Brain – Screen protocol
  - Ax T1 FS +C
  - Ax FLAIR +C
  - Cor T1 FS +C
- Optional
  - SPECT – Single Voxel
- SPECT – Multi Voxel
  - Comments
    - Add FLAIR post gad in suspected meningeal disease.
    - For brainstem and midline lesions get sagittal post gad instead of coronal.
    - For pineal lesions add thin sagittal T2 and T1 pre and post gad images.
    - Single voxel spectroscopy (TE 35 and 144) on all new mass lesions
    - Multi voxel only on suspected gliomas. For follow-up use TE 144.

**Brain 4 – Trauma**
- Indications
  - Trauma
- Sequences
  - Brain – Screen protocol
  - Ax GRE
- Comments
  - Axial GRE should have TE>25

**Brain 5 – Hemorrhage**
- Indications
  - Hemorrhage
- Sequences
  - Brain – Screen protocol
  - Ax GRE
  - Ax T1 FS +C
  - Ax FLAIR +C
  - Cor T1 FS +C

**Brain 6 – Demyelinating Disease**
- Indications
  - Demyelinating disease (e.g. – Multiple Sclerosis)
- Sequences
  - Brain – Basic protocol
  - Sag FLAIR FSE/TSE (thin-section midline)
  - Ax T1 FS +C
  - Ax FLAIR +C
  - Cor T1 FS +C

**Brain 7 – Seizure – New Onset**
- Indications
  - Seizure – New Onset
- Sequences
  - Brain – Basic protocol
  - Ax GRE
  - Ax T1 FS +C
  - Ax FLAIR +C
Brain 8 – Seizure – Possible Mesial Temporal Sclerosis

- **Indications**
  - Mesial Temporal Sclerosis, Chronic Epilepsy

- **Sequences**
  - Sag T1
  - Ax GRE
  - Ax T2 FSE/TSE
  - Ax FLAIR FSE/TSE
  - Ax DWI / ADC / B0
  - Cor T2 (angled perpendicular to temporal lobes)
  - Cor FLAIR (angled perpendicular to temporal lobes)
  - Cor T2 FSE/TSE

- **Comments**
  - Coronal sequences should be thin section perpendicular to the long axis of the hippocampus

Brain 9 – Seizure – Possible Dysplasia

- **Indications**
  - Seizure – Possible dysplasia, delayed development

- **Sequences**
  - Sag T1
  - Ax T1
  - Ax T2 FSE/TSE
  - Ax FLAIR FSE/TSE
  - Ax DWI / ADC / B0
  - Cor T2 FSE/TSE
  - Cor FSPGR / 2D Flash (3D Volume GRE – T1, thin-section, whole brain)

- **Optional**
  - Ax T1 FS +C
  - Ax FLAIR +C

- **Comments**
  - If there is a known EEG focus (not temporal), do the coronal thin T2 and FLAIR (from the MTS protocol) in the suspicious EEG location. If any abnormality noticed, then give gad.

Brain 10 – Suspected Venous Sinus Thrombosis

- **Indications**
  - Suspected venous sinus thrombosis

- **Sequences**
  - Brain – Screen protocol
  - Ax GRE
  - Cor 2DTOF SPGR
Brain 11 – Stroke

- Indications
  - Stroke, TIA, Vertebro-basilar infarct
- Sequences
  - Brain – Screen protocol
  - Ax GRE
  - Ax 3DTOF SPGR
- Optional
  - Cor 3DTOF FSPGR +C
- Ax Perfusion
- Comments
  - Gd - 20ml @ 2 ml/s for MRA and at 3-5 ml/s for perfusion.
  - Post contrast images only if subacute stroke (2-12 weeks) is suspected
  - May require separate orders for MRI Brain and MRA Brain

Brain 12 – Vascular Malformation

- Indications
  - AVM, Aneurysm
- Sequences
  - Brain – Basic protocol
  - Ax GRE
  - 3D TOF SPGR
- Comments
  - For giant aneurysm, do contrast enhanced MRA
  - May require separate orders for MRI Brain and MRA Brain

Brain 13 – MRA only

- Sequences
  - Ax 3DTOF SPGR

Brain 14 – MRV only

- Sequences
  - Cor 2DTOF SPGR
  - Sag 2DTOF SPGR (slight oblique angle)
- Optional
  - Cor 3DTOF FSPGR +C

Brain 15 – Spectroscopy only

- Indications
  - Mass, metabolic abnormality
• Sequences
  o Single voxel spectroscopy (TE 35 and 144) on all new mass lesions
  o Multi voxel only on suspected gliomas. For follow-up use TE 144.

Brain 16 – CSF Flow – NPH
• Indications
  o Normal Pressure Hydrocephalus vs. Acqueductal Stenosis
• Sequences
  o Brain 1 – Screen protocol
  o Sag 3D CISS – 1mm through aqueduct
  o Ax 3D CISS – 1mm through aqueduct (angled perpendicular to aqueduct)
  o Ax CSF flow images (angled perpendicular to cerebral acqueduct)
    • VENC = 30, 20, 10
• Comments
  o Have MD check initial CSF flow images
  o Image at additional VENCs above peak velocity
    • e.g. – if peak velocity is 8, then choose VENC of 10
    • increase VENC if aliasing is present

Brain 17 – CSF Flow – Chiari 1
• To be done

HEAD AND NECK

Base of Skull 1
• Indications
  o Tumor, Infection, Clivus tumor
• Sequences
  o Ax GRE
  o Ax DWI / ADC / B0
  o Ax T1
  o Ax FLAIR FSE/TSE
  o Ax T2 FSE/TSE FS
  o Cor T2 FSE/TSE
  o Ax T1 +C FS
  o Cor T1 +C FS
  o Sag T1 +C FS

Sella 1
• Indications
  o Pituitary dysfunction, Sellar or suprasellar mass
• Sequences
  o Sag T1
  o Cor T1 SE
  o Cor T2 FSE/TSE
  o Cor T1 FSE/TSE
  o Cor T1 +C
  o Sag T1 +C

IAC 1
• Indications
  o CPA tumor, Neurosensory hearing loss, Post IAC surgery, Pre cochlear implant, 7th nerve palsy, labyrinthitis
• Sequences
  o Sag T1
  o Ax DWI / ADC / B0
  o Cor T2 (through IAC)
  o Ax T2 (through IAC)
  o Ax T1 (through IAC)
  o Ax GRE FIESTA / CISS (through IAC)
  o Ax T1 +C FS (through IAC)
  o Cor T1 +C FS (through IAC)

Orbit 1
• Indications
  o CPA tumor, Neurosensory hearing loss, Post IAC surgery, Pre cochlear implant, 7th nerve palsy, labyrinthitis
• Sequences
  o Ax T2 FSE/TSE
  o Cor T2 FSE/TSE FS
  o Ax T1
  o Ax T1 +C FS
  o Cor T1 +C FS
• Comments
  o Sequences are through orbits to include brainstem
  o Add brain if visual field deficit and cranial nerve deficits
  o Coronal perpendicular to optic nerves
  o Axial parallel to coronal
  o If lesion is restricted to the globe, use a 3-5" surface coil to improve SNR and increase resolution

Face 1
• Indications
  o Tumor, Infection, ENT tumor, Sinus infection
• Sequences
Cor T1 FSE/TSE
Ax T1 FSE/TSE
Ax T2 FSE/TSE FS
Cor T2 FSE/TSE FS
Sag T1 FSE/TSE FS +C
Ax T1 FSE/TSE FS +C
Cor T1 FSE/TSE FS +C

Comments
Try to include the neck in at least one plane to look for lymph nodes

**Neck 1**

**Indication**
- Tumor, Infection

**Sequences**
- Cor T1 FSE/TSE
- Ax T1 FSE/TSE
- Ax T2 FSE/TSE FS
- Sag T1 FSE/TSE FS +C
- Ax T1 FSE/TSE FS +C
- Cor T1 FSE/TSE FS +C

**Neck 2 – Neck MRA**

**Indication**
- Carotid / vertebral disease

**Sequences**
- Ax 2DTOF SPGR

**Optional**
- Ax T1 FSE FS
- Cor 3DTOF FSPGR

**Comments**
- Aortic arch to circle of Willis
- Only use Axial T1 when dissection is suspected
- If not following a brain scan, also include Sag T1, Ax DWI, Ax T2, Ax FLAIR
- Brain MRI/MRA should be done at same time if not already available

**Trigeminal Nerve 1**

**Indications**
- Trigeminal neuralgia

**Sequences**
- Ax 3D CISS/FIESTA
- Ax 3D FISP
- Ax 3D SPGR T1 +C

**Optional**
Axial T2 (thin section, through CN V)

**SPINE**

**Cervical Spine 1 – Basic**

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T2 FSE/TSE
  - Ax TOF GRE
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord and Neurofibromatosis, add coronal

**Cervical Spine 2 – with contrast**

- **Indications**
  - Tumor, Infection, MS, Syrinx, Transverse myelitis
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
  - Sag T1 +C FSE/TSE FS
  - Ax T1 +C FSE/TSE FS
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord and Neurofibromatosis, add coronal

**Cervical Spine 3 – Trauma**

- **Indications**
  - Trauma
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Sag IR T2 FSE/TSE
  - Ax IR T2 FSE/TSE
  - Ax T2 FSE/TSE
- **Comments**
Can add sag T2 GRE to r/o hemorrhage
For scoliosis, tethered cord and Neurofibromatosis, add coronal

**Thoracic Spine 1 - Basic**

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord or neurofibromatosis, add coronal

**Thoracic Spine 2 – with contrast**

- **Indications**
  - Tumor, Infection, MS, Syrinx, Transverse myelitis
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
  - Sag T1 +C FSE/TSE FS
  - Ax T1 +C FSE/TSE FS
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord or neurofibromatosis, add coronal

**Thoracic Spine 3 – Trauma**

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Sag IR T2 FSE/TSE
  - Ax T2 FSE/TSE
- **Optional**
  - Ax GRE
  - Cor T1 FSE/TSE
- Cor T2 FSE/TSE

**Comments**
- For scoliosis, tethered cord or neurofibromatosis, add coronal
- Can add Sag GRE to rule out hemorrhage

### Lumbar Spine 1 – Basic

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord or neurofibromatosis, add coronal

### Lumbar Spine 2 – with contrast

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
  - Sag T1+C FSE/TSE FS
  - Ax T1+C FSE/TSE FS
- **Optional**
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- **Comments**
  - For scoliosis, tethered cord or neurofibromatosis, add coronal

### Lumbar Spine 3 – Trauma

- **Indications**
  - Disc disease, pain, radiculopathy
- **Sequences**
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Sag IR T2 FSE/TSE
  - Ax T1 FSE/TSE
Spine Survey 1

- Indications
  - Metastases, Non-localized infection, acute myelopathy / cord compression
- Sequences
  - Sag T1 FSE/TSE
  - Sag T2 FSE/TSE
  - Ax T1 FSE/TSE
  - Ax T2 FSE/TSE
  - Sag T1 +C FSE/TSE FS
  - Ax T1 +C FS (region of interest)
- Optional
  - Cor T1 FSE/TSE
  - Cor T2 FSE/TSE
- Comments
  - Have MD check sagittal images to determine where to obtain axial images
  - For scoliosis, tethered cord or neurofibromatosis, add coronal

Lumbar Neurography

- Indications
  - Post radiation therapy, eval for mass lesions, entrapment, denervation
- Sequences
  - Sag T1 Scout
  - Cor T2 FSE/TSE FS (angled along the spine)
  - Cor T1
  - Ax T2 FSE/TSE FS
  - Ax T1
• Cor  T1 +C FS
  o Ax  T1 +C FS

• Optional
  o Cor  STIR
  o Ax  STIR
  o Sag  T1 +C FS

• Comments
  o Use the Cardiac or phased array Body coil rather than the spine coil
  o Cor images should be 3mm skip 0mm, Ax Images 4mm skip 1.5
  o FOV should be from L2 to below the greater trochanter
  o Use STIR if heterogeneous/poor FS on T2 sequences
  o Post process thick slab MIPs of T2 FSE/TSE FS images if possible

Cervical Neurography (Brachial Plexus)

• Indications
  o Post radiation therapy, eval for mass lesions, entrapment, denervation

• Sequences
  o Sag  T2 FSE/TSE Scout
  o Cor  STIR
  o Cor  T1
  o AX  STIR
  o Ax  T1
  o Cor  T1 +C FS
  o Ax  T1 +C FS

• Optional
  o Cor  T2 FSE/TSE FS
  o Ax  T2 FSE/TSE FS
  o Sag  T1 +C FS

• Comments
  o Use the Cardiac or phased array Body coil rather than the spine coil
  o Cor images should be 3mm skip 0mm, Ax Images 4mm skip 1.5
  o FOV should be from C4 through T1
  o Use T2 FSE/TSE FS if STIR images fail
  o Can add flow suppression or sat bands above, below, and anterior
  o Post process thick slab MIPs of STIR images if possible