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

- Cor T1 FS +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
  - Cor T1 FS +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

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

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
    - 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 16 – CSF Flow – NPH

- Indications
    - Normal Pressure Hydrocephalus vs. Acqueductal Stenosis
- Sequences
    - Brain 1 – Screen protocol
    - Sag 3D CISS – 1mm through aqueduct
    - Ax 3D CISS – 1mm through aqueduct (angled perpendicular to aqueduct)
    - Ax CSF flow images (angled perpendicular to cerebral acqueduct)
        - VENC = 30, 20, 10
- Comments
    - Have MD check initial CSF flow images
    - 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
    - Tumor, Infection, Clivus tumor
- Sequences
    - Ax GRE
    - Ax DWI / ADC / B0
    - Ax T1
    - Ax FLAIR FSE/TSE
    - Ax T2 FSE/TSE FS
    - Cor T2 FSE/TSE
    - Ax T1 +C FS
    - Cor T1 +C FS
    - Sag T1 +C FS

Sella 1

- Indications
    - Pituitary dysfunction, Sellar or suprasellar mass

- Sequences
  - Sag T1
  - Cor T1 SE
  - Cor T2 FSE/TSE
  - Cor T1 FSE/TSE
  - Cor T1 +C
  - Sag T1 +C

IAC 1

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

Orbit 1

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

Face 1

- Indications
  - 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

    - 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

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
    - Ax T1 +C FS
- Optional
    - Cor STIR
    - Ax STIR
    - Sag T1 +C FS
- Comments
    - Use the Cardiac or phased array Body coil rather than the spine coil
    - Cor images should be 3mm skip 0mm, Ax Images 4mm skip 1.5
    - FOV should be from L2 to below the greater trochanter
    - Use STIR if heterogeneous/poor FS on T2 sequences
    - Post process thick slab MIPs of T2 FSE/TSE FS images if possible

Cervical Neurography (Brachial Plexus)

- Indications
    - Post radiation therapy, eval for mass lesions, entrapment, denervation
- Sequences
    - Sag T2 FSE/TSE Scout
    - Cor STIR
    - Cor T1
    - AX STIR
    - Ax T1
    - Cor T1 +C FS
    - Ax T1 +C FS
- Optional
    - Cor T2 FSE/TSE FS
    - Ax T2 FSE/TSE FS
    - Sag T1 +C FS
- Comments
    - Use the Cardiac or phased array Body coil rather than the spine coil
    - Cor images should be 3mm skip 0mm, Ax Images 4mm skip 1.5
    - FOV should be from C4 through T1
    - Use T2 FSE/TSE FS if STIR images fail
    - Can add flow suppression or sat bands above, below, and anterior
    - Post process thick slab MIPs of STIR images if possible