Skagit RADIOLOGY INCORPORATED PROFESSIONAL SERVICES	**Neuro: MR Protocols**		
	Reviewed: No Changes	Date: 4/26/2022	D. Chaudry
	Revised:	Date:	

Brain protocols:

N 1: Brain MRI without contrast

N 2: Pre- and post-contrast brain MRI

N 3 is deleted

N 4: Brain MRI without *or* pre-/post-contrast (seizure protocol)

N 5: Pre- and post-contrast brain MRI (multiple sclerosis protocol)

N 6: Pre- and post-contrast brain MRI (internal auditory canal protocol)

N 7: Pre- and post-contrast brain MRI (pituitary protocol)

N 8: Pre- and post-contrast orbital MRI

N 9: Pre- and post-contrast brain MRI (cavernous sinus protocol)

N10: Pre- and post-contrast brain MRI (cranial nerve protocol)

Neurovascular protocols:

N11: Pre- and post-contrast neck MR angiography

N12: Brain MR angiography without contrast

N13: Brain MR venogram without contrast

Combined protocols:

Stroke protocol: N2 + N12 + N11

Head and neck protocols:

ENT 1: Pre- and post-contrast neck MRI

ENT 2: Temporomandibular joint MRI

Peripheral nerve protocols:

PN 1: Pre- and post-contrast brachial plexus MRI

PN 2: Pre- and post-contrast sacral plexus MRI

N1: Brain MRI without contrast

Indications: general screening; headaches, stroke, bleeds, memory loss.

Sequences:

- Sagittal FLAIR
- Axial T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial GRE or SWI
- Coronal T2 FSE
- Axial Diffusion with ADC

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- Substitute sagittal T1 SE for FLAIR in patients 10 years of age or younger

N2: Pre- and post-contrast Brain MRI

Indications: tumor, infection

Sequences:

- Sagittal FLAIR
- Axial T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial GRE or SWI
- Coronal T2 FSE
- Axial Diffusion with ADC
- Post-Gd axial & coronal VIBE with coronal T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE with coronal reformats (3mm thick).

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- 3D VIBE: Perform with 0.8-1.0 mm thick isotropic voxels. Radiologists can request additional sagittal reformats as needed.
- If post-Gd axial 3D VIBE performed, then omit the post-Gd axoal and Coronal T1 SE with fat saturation.
- Substitute sagittal T1 SE for FLAIR in patients 10 years of age or younger

N4: Brain MRI without contrast or pre-/ post-contrast (seizure protocol)

Indications: seizure disorder, first time seizures

Sequences:

- Sagittal FLAIR
- Axial T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial GRE or SWI
- Coronal thin slice T2 FSE (hippocampi)
- Axial Diffusion with ADC
- *Opt:* Post-Gd axial & coronal T1 SE with fat saturation OR:
- Post-Gd axial 3D VIBE with coronal reformats (3mm thick).

Comments:

- Give IV contrast for new onset seizure workups only.
- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- Substitute sagittal T1 SE for FLAIR in patients 10 years of age or younger

N5: Pre- and post-contrast Brain MRI (multiple sclerosis protocol)

Indications: assess for multiple sclerosis or ADEM

Sequences:

- Sagittal FLAIR
- Axial T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial GRE or SWI
- Coronal T2 FSE
- Axial Diffusion with ADC
- Post-Gd axial & coronal T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE with coronal reformats (3mm thick).

Comments:

- Sagittal FLAIR improves detection of corpus callosum lesions
- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- 5-minute delay before post-Gd T1 weighted sequences; should acquire axial T2 FSE sequence during this time

N6: Pre- and post-contrast Brain MRI (internal auditory canal protocol)

Indications: vertigo, cerebellopontine angle masses, Ramsay Hunt syndrome

Sequences:

- Sagittal T1 SE
- Axial FLAIR
- Axial Diffusion with ADC
- Axial GRE or SWI
- Coronal localizer tru-FISP (IAC only)
- Axial 3D CISS (IAC)
- Thin slice axial T1 SE with fat saturation (IAC)
- Post-Gd thin slice axial T1 SE with fat saturation (IAC)
- Post-Gd thin slice coronal T1 SE with fat saturation (IAC)
- Whole head post-Gd axial T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE (3mm thick).

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard

N7: Pre- and post-contrast Brain MRI (pituitary protocol)

Indications: pituitary masses

Sequences:

- Sagittal FLAIR
- Axial FLAIR
- Axial GRE or SWI
- Axial Diffusion with ADC
- Thin-slice sagittal T1 SE (pituitary fossa)
- Thin-slice coronal T1 SE (pituitary fossa)
- Thin-slice coronal T2 FSE (pituitary)
- Coronal dynamic thin-slice T1 SE (pre- and post-Gd)
- Delayed post-Gd thin-slice coronal T1 SE (pituitary)
- Delayed post-Gd thin-slice sagittal T1 SE (pituitary)
- Whole head post-Gd axial T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE (3mm thick).

Comments:

- For macroadenomas (ie: visible mass > 1 cm in size), coronal dynamic thin-slice T1 SE can be omitted.
- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard

N8: Pre- and post-contrast orbital MRI

Indications: orbital masses, optic neuritis, diplopia

Sequences:

- Sagittal T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial Diffusion with ADC
- Axial GRE or SWI
- Coronal STIR (orbits)
- Thin-slice axial T1 SE (orbits)
- Post-Gd thin slice axial T1 SE with fat saturation (orbits)
- Post-Gd thin slice coronal T1 SE with fat saturation (orbits)
- Whole head post-Gd axial T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE (3mm thick).

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard

N9: Pre- and post-contrast Brain MRI (cavernous sinus protocol)

Indications: cavernous sinus thrombosis, carotid-cavernous fistulas

Sequences:

- Sagittal FLAIR
- Axial T2 FSE
- Axial FLAIR
- Axial GRE or SWI
- Axial T1 SE
- Axial Diffusion with ADC
- Coronal dynamic thin-slice T1 SE (pre- and post-Gd)
- Post-Gd thin-slice coronal T1 SE with fat saturation (cavernous sinuses)
- Whole head post-Gd axial T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE (3mm thick).

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- Substitute sagittal T1 SE for FLAIR in patients 10 years of age or younger

N10: Pre- and post-contrast brain MRI (cranial nerve protocol)

Indications: cranial nerve V impingement symptoms, skull base lesions

Sequences:

- Sagittal T1 SE
- Axial T2 FSE
- Axial FLAIR
- Axial Diffusion with ADC
- Axial GRE or SWI
- Axial 3D CISS (pons and midbrain): coronal and sagittal reconstructions
- Thin-slice axial T1 SE with fat saturation (skull base)
- Post-Gd thin slice axial T1 SE with fat saturation (skull base)
- Post-Gd thin slice coronal T1 SE with fat saturation (skull base)
- Whole head post-Gd axial T1 SE with fat saturation *OR:*
- Post-Gd axial 3D VIBE (3mm thick).

Comments:

- Send b1000 DWI (#2) and ADC to PACS. Keep b0 and b500 DWI images in hard drive for 2 weeks, then can discard
- CISS parameters: flip angle 65 degrees, slice thickness 1 mm, 384 x 256 matrix, FOV 18-20 cm, NEX 2

N11: Pre- and post-contrast neck MR Angiography

Indications: carotid stenosis, part of stroke workup, carotid dissection

Sequences:

- Axial tru-FISP
- Sagittal tru-FISP
- Dynamic coronal MRA (pre-, arterial, venous phases)
- Rotating 3D MIP reformats
- *OPT:* axial pre-Gd thin-slice T1 SE with fat saturation (dissection)

Optional black blood imaging for vasculitis

- Axial T1 FSE: skull base through aortic arch
- Coronal T1 FSE: skull base through aortic arch
- Post-Gd axial double inversion recovery with fat saturation: skull base through aortic arch

Comments:

N12: Brain MR angiography without contrast

Indications: part of stroke workup, intracranial aneurysms

Sequences:

- Axial 3D TOF (time of flight)
- Rotating 3D MIP reformats of right ICA. Left ICA, posterior circulation, as well as of vessels as a whole (flip and rotate)

Comments:

N13: Brain MR venogram without contrast

Indications: evaluate for sinus thrombosis

Sequences:

- Sagittal T1 SE
- Coronal 2D TOF (time of flight) with inferior saturation band
- Rotating 3D MIP reformats of venous structures

Comments:

- Suggested 2D TOF parameters: TR/TE = 32-40 / 8-12; flip angle 50-70 degrees, slice thickness 1.5-3.0 mm, 144 x 256 matrix, NEX 1-2

ENT 1: Pre- and post-contrast neck MRI

Indications: pituitary masses

Sequences:

- Sagittal T1 FSE
- Sagittal STIR
- Axial T1 FSE
- Axial STIR
- Coronal T1 FSE
- Coronal STIR
- Post-Gd axial T1 FSE with fat saturation
- Post-Gd coronal T1 FSE with fat saturation
- Post-Gd sagittal T1 FSE with fat saturation

Comments:

- Axial sequences: use 5mm slice thickness with 1 mm (20%) skip

ENT 2: Temporomandibular joint MRI

Indications: TMJ pain

Sequences:

- Axial T1 SE
- Coronal PD FSE (closed mouth)
- Sagittal PD FSE (closed mouth)
- Sagittal T2 FSE with fat saturation (closed mouth)
- Coronal PD FSE (open mouth)
- Sagittal PD FSE (open mouth)

Comments:

- Place fiducials over the symptomatic side
- Perform coronal and sagittal sequences through both sides to assess symmetry (until a dedicated TMJ coil is acquired.)
- Sagittal T2 FSE with fat saturation: adjust TE to 40 msec (+/- 5 msec).

PN 1: Non-contrast vs pre-/post-contrast brachial plexus MRI

Indications: brachial plexopathy from tumor invasion or radiation, traumatic nerve injuries

Sequences:

- Coronal T2 FSE (large FOV)
- Axial T1 SE (large FOV)
- Axial T1 SE
- Axial STIR
- Coronal T1 SE
- Coronal STIR
- Sagittal T1 SE
- Sagittal STIR
- *Opt:* Post-Gd axial T1 SE with fat saturation
- *Opt:* Post-Gd coronal T1 SE with fat saturation
- *Opt:* Post-Gd sagittal T1 SE with fat saturation

Comments:

- Initial 2 sequences will help to assess for asymmetry between the brachial plexus regions.
  - Other sequences are high resolution images through the affected side only

PN 2: Non-contrast vs pre-/post-contrast sacral plexus MRI

Indications: sciatic nerve impingement

Sequences:

- Oblique coronal T1 SE
- Oblique coronal STIR
- Axial T1 SE
- Axial STIR
- *Opt:* Post-Gd oblique coronal T1 SE with fat saturation
- *Opt:* Post-Gd axial T1 SE with fat saturation

Comments: