Akron Radiology Inc. Technique Manual For MRI

Version 2018

Summa Health System
CCOC
UH Portage Medical Center
Western Reserve Hospital
Affiliated Imaging Centers: Green, Hudson, White Pond, Medina, PIC

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NEUROLOGIC IMAGING:

BRAIN (ROUTINE) Note: Flow compensation is in use for precontrast T(1)

Sagittal	T(1) SE
Axial	FLAIR
	T(2) FSE
	Diffusion
	Susceptibility/BOLD/GRE
Coronal	T(1) SE

BRAIN (R/O TUMOR including METS **or** Ordered with Contrast)

Routine Brain as above (EXCEPT DELETE CORONAL T(1) SE) but add:

Axial	T(1) SE	
Post Gad:	Axial	T(1) SE
	Coronal	T(1) SE

If tumor visualized include Post Gad Sagittal T(1) SE

BRAIN (KNOWN TUMOR)

Routine Brain as above (EXCEPT DELETE CORONAL T(1) SE) but add:

Axial	T(1) SE	
Post Gad:	Axial	T(1) SE
	Sagittal	T(1) SE
	Coronal	T(1) SE

BRAIN (MS)

Routine Brain as above PLUS:

Axial	T(1) SE
Sagittal	FLAIR

Post Gad: Axial T(1) SE

Do Post Gad sequence as a 5 minute delay

BRAIN (REFRACTORY SEIZURES <70 y.o.)

Sagittal	T(1) SE
Axial	FLAIR
	T(2) FSE
	GRE
	Diffusion
Coronal	T(1) SE
	T(2) FSE
	FLAIR

Post Gad: (Only if requested by referring physician):

Axial	T(1) SE
Coronal	T(1) SE

BRAIN (STROKE)

Routine Brain

Only if specified add:

Circle of Willis MRA

Carotid MRA

Only if specified: Perfusion: Power inject 20cc of Gad w/ 2sec delay. Radiologist will choose level.

BRAIN (AVM)

Routine Brain

Circle of Willis MRA

Sagittal Sinus MRV

BRAIN (ANEURYSM)

Routine Brain

Circle of Willis MRA

BRAIN (MENINGITIS & HIV)

Axial T(1) SE
T(2) FSE
FLAIR
Diffusion

Post Gad: Axial T(1) SE

BRAIN (BLEED)

Routine Brain

Axial T(2) GRE

INTERNAL AUDITORY CANALS (Bell's Palsy (7th nerve), Trigeminal (5th nerve) Neuralgia)

Brain:	Axial	T(2) SE FLAIR Diffusion
Pre Gad:	Axial	T(1) SE FatSat 3D T(2) GRE (CISS)
(through area of interest)		
Post Gad:	Axial	T(1) SE FatSat
	Coronal	T(1) SE
(through area of interest)		

T(1) post contrast of Brain is optional.

Localize examination for area of concern:
- IAC – Internal Auditory Canals
- 7th nerve – Slightly lower than for IAC
- 5th nerve - Brainstem

PITUITARY

Axial T(2) FSE
FLAIR
(through entire brain)

Pre Gad: Coronal & Sagittal thin T(1) SE (through pituitary)
Post Gad: Always use ½ DOSE GAD at 90sec

Coronal dynamic bolus scan
Coronal thin T(1) SE
Sagittal T(1) SE

CERVICAL SPINE ROUTINE

FOV – Skull base through T1-2

Sagittal	T(1) SE
	T(2) FSE
	STIR
Axial	T(2) Spoiled GE
	T(2) FSE

CERVICAL SPINE (SYRINX)

FOV – Skull base through T1-2

Sagittal	T(1) SE
	T(2) FSE
Axial	T(1) SE
	T(2) Spoiled GE

CERVICAL SPINE (Post Op)

Routine Cervical Spine <u>without Gad</u>

CERVICAL SPINE (TUMOR or whenever Gad is requested)

FOV – Skull base through T1-2

Pre Gad:	Routine Cervical Spine	
Post Gad:	Axial	T(1) SE through entire spine
	Sagittal	T(1) SE

THORACIC SPINE

Sagittal	T(1) SE
	T(2) FSE
	STIR
Axial	T(1) through entire spine
	T(2) GRE through entire spine

LUMBAR SPINE

FOV -

Sagittal	FOV: T11-12 through upper sacrum
	T(1) SE
	T(2) FSE
	STIR
Axial	FOV: T12-S1
	T(1) SE
	T(2) FSE – angled blocks through disc spaces (2-3 blocks only)
	T(2) FSE – straight - if entire canal was not included in angled blocks

If scoliosis present add:

Coronal	T(1) SE

LUMBAR SPINE (POST OP or whenever gadolinium contrast is requested)

FOV – T11-12 through upper sacrum

Post Op – Scan Pre & Post Gad T(1) Axials over entire spine

Pre Gad:	Axial	T(1) SE
		T(2) SE
	Sagittal	T(1) SE
	Sagittal	T(2) FSE
	Sagittal	STIR
Post Gad:	Axial	T(1) SE
	Sagittal	T(1) SE

SPINE (CSF FLOW)

Use pulse gating

Axial:	2D Phase Contrast, flow compensation
Sagittal:	2D Phase Contrast, flow compensation

ENTIRE SPINE SURVEY (CORD COMPRESSION, INFECTION, TUMOR, METS)

Perform in TWO SETS of Sagittal acquisitions (Use body coil if tall patient):

1. Total C spine and upper T spine
2. Lower T spine and total L spine

Sagittal	T(1) SE
	T(2) FSE

If ordered with Gad or if abnormal findings present:

Sagittal post	T(1) SE
Axial post	T(1) SE straight sequence only with angles to discs

ORBITS

Brain:	Axial	T(2) SE
		FLAIR
		Diffusion

Cover entire orbit from brainstem forward. T(1) post contrast of Brain is optional.

Orbits

Pre Gad:	Axial	T(1) SE
	Coronal	T(1) SE FatSat
		T(2) FSE FatSat
		STIR
Post Gad:	Coronal	T(1) SE FatSat
	Axial	T(1) SE FatSat

NECK

Pre Gad:	Sagittal	T(1) SE
	Axial	T(1) SE FatSat
	Axial	T(2) FSE FatSat
	Coronal	T(2) FSE FatSat
Post Gad:	Axial	T(1) SE FatSat
	Coronal	T(1) SE FatSat

TMJ (Perform at St. Thomas only - with dedicated TMJ coil)
(Use Flex coil as close to skin as possible)

Sagittal	T(2) FSE (Bilateral, Closed position only)
	Proton Density FatSat (Bilateral, Open & Closed positions)
Coronal	T(1) SE

Musculoskeletal Imaging

KNEE

Sagittal	PD FatSat	(DO NOT ANGLE SAGITTAL IMAGES)
	PD	
	T(2)	
Axial	PD FatSat	
Coronal	PD FatSat	
	T(1) SE	

If structural problem related to patella include:

Axial T(2) FSE

KNEE (ARTHROGRAM)

Post Injection:

Coronal	T(1) FatSat
	T(2) FSE FatSat
Sagittal	T(1) FatSat
	T(2) FSE FatSat

SHOULDER

Coronal	T(1) FSE
	PD FatSat
	T(2) FSE
Sagittal	T(1) FSE
	T(2) FatSat
Axial	PD FatSat

If r/o labral pathology include:

Axial T(1) SE

Set up coronal and sagittal off of axial at glenohumeral joint
Sagittal = parallel to joint
Coronal = perpendicular to joint

SHOULDER (ARTHROGRAM)

Post Injection:

Coronal	T(1) FatSat
	T(2) FatSat
Coronal	T(1) FatSat with arm raised above head (ABER)
Sagittal	T(1) FatSat
	T(1) SE
Axial	T(1) FatSat

BRACHIAL PLEXUS

Large FOV bilateral:

Axial	T(1) SE
Coronal	T(1) SE
	T(2) FatSat

Small FOV unilateral of affected side:

Axial	T(2) FatSat
Sagittal	T(2) FatSat

PECTORALIS MAJOR

Use shoulder coil low across chest/upper arm.

Small FOV (upper chest from humeral neck to mid shaft for pectoralis insertion):

Axial	STIR
	T(1) SE

Moderate FOV (plane of pectoralis tendon as seen from axials):

Coronal	T(1) SE
	PD FatSat

Moderate FOV (plane perpendicular to coronal):

Sagittal	T(1) SE
	T(2) FatSat

WRIST

Plain films needed for baseline

Coronal	PD FatSat
	T(2) FatSat
	T(1) SE
Axial	PD (through AOI and perpendicular to joint space)
	T(2) FatSat
Sagittal	T(2) FatSat (through AOI)

Patient is positioned head first with the fingers straight out.
Smallest FOV possible – Cover distal 2–3 cm of radius/ulna through CMC joints.

WRIST (ARTHROGRAM)

Post Injection:

Axial	T(1) FatSat
Sagittal	T(1) FatSat
Coronal	T(1) SE
	T(1) FatSat
	T(2) FatSat

HAND

Coronal	T(1) SE	
	PD FatSat	
	T(2) FatSat	
Sagittal	T(2) FatSat	

High Resolution:

Axial	PD (high resolution)
	T(2) FatSat (high resolution)

HAND (ARTHRITIS)

Screening for inflammatory arthritis of both hands and wrists.
FOV to include distal radioulnar joint through MCPS of both hands.

Pre Gad:	Coronal	T(1) SE
		PD FatSat
		T(2) FatSat
	Axial	PD
		T(2) FatSat
	Sagittal	T(2) FatSat
Post Gad:	Axial T(1)	FatSat
	Coronal	T(1) FatSat

DIGIT

Axial	PD
	T(2) FatSat
Coronal	T(1) SE
	T(2) FatSat
Sagittal	PD (high resolution)
	T(2) FatSat

HIPS

Need plain films for baseline
Except for Sagittals study is of **both** hips (body coil) regardless of what is requested.
Axials to include **entire** pelvis.

Bilateral:

Coronal	T(1) SE
	STIR
Axial	T(2) FatSat
	T(1) SE

Unilateral:
(affected side only, small FOV, centered on joint space)

Sagittal	PD FatSat
Coronal	T(2) FatSat
Axial Oblique	PD FatSat (angled to neck)

HIP (ARTHROGRAM)

Post injection:

Axial	T(1) SE FatSat
	T(2) FatSat
Coronal	T(1) SE
	T(1) SE FatSat
	T(2) FatSat
Sagittal	T(1) SE FatSat

Use flex coil on affected hip with small FOV.

PELVIS (BONY)

Routine Hips (to cover entire pelvis through SI joints on coronals and through iliac bone on axials).

Sagittal	PD FatSat

QUADRICEPS MUSCLE (THIGH)

Both sides with large FOV:

Coronal	T(1) SE
	T(2) FatSat
Axial	T(1) SE
	T(2) FatSat

Affected side only with small FOV:

Sagittal	T(2) FatSat

ADDUCTOR DETACHMENT (ATHLETIC HERNIA/PUBALGIA)

Large FOV of pelvis:

Coronal	T(1) SE
	T(2) FatSat
Axial	T(2) FatSat

Small FOV centered over pubic bone:

Axial Oblique – 90 degrees to long axis of symphysis as seen on sagittal.

Axial Oblique	PD
	T(2) FatSat
Sagittal	T(2) FatSat (through symphysis)
Sagittal	T(2) FatSat (through affected hip)

SACROILIAC JOINTS (all with contrast unless contraindicated)

Plain films are desired for baseline

FOV centered on sacrum and SI joints

Coronal oblique (parallel to long axis of sacrum)

T(1) FSE
T(1) Fat Sat
T(2) Fat Sat

Axial oblique (perpendicular to coronal plane scan)

T(1) FSE
T(2) FatSat

Post-Gad T(1) Fat Sat in both planes as above

SACRUM

Axial	T(1) SE
	T(2) FSE
Coronal	T(1) SE
	T(2) FatSat
Sagittal	T(2) SE

EXTREMITY MASS

Required: conventional radiographs and skin marker on all cases.
Skin marker above & below lesion, not directly over lesion.
Inject Gad on all tumor cases regardless of region.

Pre Gad:	Axial	T(2) SE	(obtain first - most important!)
		T(1) SE	
		T(1) FatSat	
		T(2) FatSat	
In plane where the pathology is best seen		T(1) SE	
		T(2) FatSat	
Post Gad:	Axial	T(1) FatSat	
	Same 2nd plane as pre gad	T(1) FatSat	

EXTREMITY INFECTION

Pre Gad	Axial	T(1) SE
		T(2) FatSat
In plane where pathology is best seen		T(1) SE
		T(2) FatSat
Remaining plane		T(1) SE (when imaging small joints)
		T(2) FatSat
Post Gad:	Axial	T(1) FatSat
	Same 2nd plane as pre gad	T(1) SE FatSat

THIGH (OTHER THAN FOR MASS)

Large FOV bilateral thighs

Coronal	T(1)
Coronal	T(2) FatSat or STIR
Axial	T(2) FatSat or STIR

Small FOV unilateral side of symptoms

Coronal	T(1)
Coronal	T(2) FatSat or STIR
Axial	T(1)
Axial	T(2) FatSat or STIR
Sagittal	T(2) FatSat or STIR

LEG (OTHER THAN FOR MASS)

Large FOV bilateral legs

Coronal	T(1)
Coronal	T(2) FatSat or STIR
Axial	T(2) FatSat or STIR

Small FOV unilateral side of symptoms

Coronal	T(1)
Coronal	T(2) FatSat or STIR
Axial	T(1)
Axial	T(2) FatSat or STIR
Sagittal	T(2) FatSat or STIR

ANKLE/FOOT

Plain films are required if exam is for bone abnormality.
Hindfoot is same as ankle, forefoot is midfoot forward.
Foot-axial is long axis, Ankle-axial is short axis.

Sagittal	T(1) SE
	T(2) FatSat
Coronal	T(1) SE
	PD
	T(2) FatSat
Axial	T(2) FatSat
	PD

FOOT (NEUROMA)

Routine Ankle/Foot

Drop:		Coronal	PD
Add:	Pre Gad:	Coronal	T(1) FatSat
	Post Gad:	Coronal	T(1) FatSat
		Sagittal	T(1) FatSat

FOOT (INFECTION)

Axial is long axis, Coronal is short axis

Sagittal	T(1) SE
	T(2) FatSat
Coronal	T(1) SE
	T(2) FatSat
Axial	T(1) SE
	T(2) FatSat

Post Gad:

Sagittal	T(1) FatSat
Coronal	T(1) FatSat

ELBOW

Axial	PD
	T(2) FatSat
Sagittal	T(2) FatSat
Coronal	T(1) SE
	PD FatSat
	T(2) FatSat

Set coronals and sagittals off of axial acquisition. Use epicondyles to set slices. Always include bicipital tuberosity.

ELBOW (ARTHROGRAM)

Post Injection:

Axial	T(1) FatSat
Coronal	T(1) FatSat
	T(2) FatSat
Sagittal	T(1) FatSat

ELBOW/ARM (BICEP RUPTURE)

Axial	T(1) SE
	PDFS
Sagittal	T(1) SE
	T(2) FSE
Coronal	T(1) SE
	STIR

FOREARM

Axial	T(1) SE
	T(2) FatSat
Sagittal	PD FatSat
Coronal	T(1) SE
	PD FatSat

TOTAL BODY FOR MULTIPLE MYELOMA

Coronal	T(1) SE
	STIR

Cover areas of interest in large field of view including as little as

1. Head/neck
2. Chest and upper abdomen/upper extremities and lower abdomen
3. Pelvis/lower extremities

Abdominal Imaging

LIVER (ROUTINE)

Axial	T(1) GE	(all sequences are single breath hold)
	T(2) Ultrafast SE	
	IN / OUT	
	Diffusion b0-50 and 800-1000	
Coronal	T(1) GE	
	STIR	

Post Gad:	Axial	T(1) GE	
	Coronal	T(1) GE	
	Dynamic study with power injection at 0sec(arterial), immediate (venous), 90sec, 3min, 5min, & 15min.		

LIVER (HEMANGIOMA)

Routine Liver

Add: Axial T(2) Ultrafast SE high (triple) TE

LIVER (FOLLOW UP)

Axial	T(1) SE		
	T(1) GE	(all GE & Ultrafast SE sequences are single breath hold)	
	T(2) Ultrafast SE		
	IN / OUT		
	Diffusion b0-50 and 800-1000		
Coronal	T(1) GE		
	STIR		

Post Gad:	Axial	T(1) GE	(begin acquisition at 90sec post injection, use power injector)
	Coronal	T(1) GE	

LIVER (FATTY INFILTRATION)

Axial	T(1) SE
	T(2) Ultrafast SE
	IN / OUT

LIVER (HEPATOMA, CIRRHOSIS, METS) - EOVIST

Pre Eovist:

Axial	T(1) Ultrafast Spoiled GE
	T(2) Breathold
	IN / OUT
Coronal	T(1) GRE
	T(2) Breathold

Post Eovist:

Axial	T(1) Ultrafast Spoiled GE

(Use bolus tracking over left ventricle)
Dynamic study with power injection at 0sec(arterial), immediate (venous), 90sec, 3min, 5min, 10min, & 20min.

Axial	Diffusion b0-50 and 800-1000 (during delay)
Coronal (20 min)	T(1) Ultrafast Spoiled GE

BILIARY SYSTEM – MRCP

Biliary System:

Coronal	T(2) Ultrafast SE	(single breath hold)
	T(2) Balanced GE	
	T(2) Thick Slab	
	T(2) 3D restored 384 Triggered	
Axial	T(2) T(2) FatSat	

18 rotations through 180degrees T(2) Ultrafast SE thin slice breathold (in best angle from thick slab)

Post processing MIPS & Source images

Liver:

Axial	T(1) SE
	T(2) SE
	In/Out phase GRE
	Diffusion b0-50 and 800-1000
Coronal	T(1) SE

RENAL

Axial	In/Out phase GRE	
	T(2) FSE	
	T(2) FatSat	
Coronal	T(1) GE single breath hold	
	T(2) FSE	
	STIR	
Post Gad:	Axial	T(1) GE single breath hold
	Coronal	T(1) GE single breath hold
	Dynamic study with power injection at 0sec(arterial), immediate (venous), 90sec, 3min, 5min, & 15min.	
	Axial	Diffusion b0-50 and 800-1000 (during delay)

MR UROGRAM

Perform MR Renal with Gad as above but add Coronal thick slab T2 in place of 15 min post-gad sequence

ADRENAL GLAND

Axial	T(1) SE	
	T(1) FatSat	
	In Phase / Out of Phase GE	
Coronal	T(2) FSE	

PANCREAS

Pre Gad:	Axial	T(1) GE FatSat
		T(2) FSE FatSat
		Steady State GE
		T(2) FSE (Breathhold)
		Diffusion b0-50 and 800-1000
	Coronal	Steady State GE
Post Gad:	Axial	T(1) GE FatSat
	Dynamic study with power injection at 0sec(arterial), immediate (venous), 90sec, 3min, 5min, & 15min.	

If pancreatic cyst known or detected then add thin slice T(2) MRCP sequence

ABDOMEN – NONSPECIFIC (ABDOMINAL PAIN, OTHER)

Field of view – diaphragm through iliac crests

Axial	T(1)
	T(2) fat sat
	IN/OUT
Coronal	T(2)

SMALL BOWEL ENTEROGRAPHY

Prep – 4-6hr NPO

Contrast – 3 x 450ml bottles of Volumen one hour prior to imaging

Optional glucagon – 1 mg IM (contraindicated in glaucoma, known pheochromocytoma or insulinoma)

Field of view – Coronal performed with large FOV to include entire abd/pelv

Patient position - PRONE

Pre Gad:	Coronal	T(2) FatSat (Breathhold)
		Steady State GE
		Diffusion 0-50 and 800-1000
	Axial	T(2) FatSat Abdomen (Breathhold)
		T(2) FatSat Pelvis (Breathhold)
Post Gad:	Coronal	T(1) Multiphase 0, 30, 70 sec
	Axial	T(1) FatSat Abdomen
		T(1) FatSat Pelvis

PELVIS (SOFT TISSUES)

Axial	T(1) SE
	T(2) FatSat
Axial	Diffusion b0-50 and 800-1000
Coronal	T(2) FatSat
Sagittal	T(2) FSE

Post Gad (if requested): T(1) all planes (not Fat Sat)

PELVIS (ENDOMETRIOSIS)

Axial	T(1) SE Fat Sat
	T(2) FatSat
Coronal	T(2) FatSat
Sagittal	T(2) FSE

PELVIS (UTERINE ARTERY EMBOLIZATION)

Pre Gad:

Axial	T(1) Spoiled GE 2D FatSat
	T(2) FatSat
	T(2) SE – angled parallel to long axis of uterus
Sagittal	T(2) SE
Coronal	T(2) SE - angled perpendicular to long axis of uterus

Post Gad:

Axial	T(1) Spoiled GE 2D FatSat

PELVIS (PELVIMETRY)

Axial	T(1) FSE
Sagittal	T(1) FSE
Oblique (inlet) Coronal	T(1) FSE

PELVIS (PLACENTA)

Axial	T(1) GE single breath hold
	T(2) TSE (Breathold)
Sagittal	T(2) TSE (Breathold)
Coronal	T(2) TSE (Breathold)

RECTAL OR CERVIX (STAGING FOR TUMOR)

Note: Please make attempt to get Colonoscopy/Sigmoidoscopy report for rectal CA cases and put in PACS

Contrast – optional use of up to 100ml of ultrasound gel in rectum

Field of view – lower pelvis only – small field of view

Axial oblique (perpendicular to long axis of rectum at level of tumor)

	T(1) (no fat sat or gad on any sequences)
	T(2) FSE
	Diffusion b0-50 and 800-1000
Sagittal	T(2) FSE
Coronal	T(2) FSE

PROSTATE

Preference is to wait four weeks after prostate biopsy

Pre-Gad:	Axial	T(1) Whole pelvis
	All remaining sequences small field of view	
	Axial	T(2) FSE
	Sagittal	T(2) FSE
	Coronal	T(2) FSE
	Axial	Diffusion b0-50 and 800-1000
Post-Gad:	Axial Multiphase T(1)	

SCROTUM

Use small flex coil

Pre Gad:	Axial	T(1) SE
		T(2) FSE
	Sagittal	T(1) SE
Post Gad:	Axial	T(1) SE
	Sagittal	T(1) SE

ABDOMEN/PELVIS (SUSPECTED APPENDICITIS IN PREGNANCY)

Axial	T(1)
	T(2) SSFSE breath hold with fat sat
	IN/OUT
Sagittal	T(2) SSFSE breath hold
Coronal	T(2) SSFSE breath hold with wide field of view to include kidneys/GB

CHEST

Perform in prone position when attention to anterior structures

Axial	T(1) SE
Coronal	T(1) SE
	T(2) FSE

MRA Imaging

Note: Use of Ablovar (blood pool agent) only at discretion of interpreting radiologist. Not to be used for carotid MRA

CIRCLE OF WILLIS (HEAD OR INTRACRANIAL)

Sagittal Scout

Axial: 3D TOF MRA, combined MOTSA

CAROTID (NECK OR EXTRACRANIAL)

Pre Gad:	Axial:	2D TOF MRA of entire carotid system
Post Gad:	Axial:	3D TOF MRA (from Aortic Arch to Circle of Willis)

CAROTID (NON-CONTRAST) (NECK OR EXTRACRANIAL)

Axial:	2D TOF MRA entire carotid system
Axial:	3D TOF MRA of carotid bifurcation only

MR VENOGRAM HEAD

Pre-Gad:	ParaSagittal:	2D TOF MRA
	ParaAxial:	2D TOF MRA
Post Gad:	Wide FOV	2D TOF MRV

Do not use contrast if performing MRA during same exam

RENAL ARTERIES

Coronal	T(2) Balanced GE
Axial	T(2) Balanced GE
	T(2) TSE
	T(1) Spoiled GE

Run coronal 3D subtraction & axial timing bolus sequences.

Post Gad: 3D-TOF MRA of renal arteries

RENAL ARTERIES (DONOR)

Axial	T(1) Spoiled GE
Coronal	T(1) SE
	T(2) FSE

Run breathold no contrast mask & axial timing bolus sequences.

Post Gad: 3D-TOF MRA of renal arteries
Coronal T(1) SE

RENAL VEINS

Axial:	T(2) Balanced GE
Coronal:	T(2) Balanced GE

Breathold no contrast mask

Post Gad: Timing run w/ 10sec scan delay, 5cc test bolus just above renal arteries.
3D-TOF MRA breathold with double dose (35cc)

Add Renal Protocol post Gad if examination performed to evaluate tumor.

PORTAL VEIN

Axial	T(2) Balanced GE
Coronal	T(2) Balanced GE
Sagittal	2D TOF MRA with satbands on one side through portal vein
	2D TOF MRA with satband on <u>other</u> side through portal vein
	T(1) SE BlackBlood

Breathold no contrast mask

Post Gad: Timing run w/ 30sec scan delay, 5cc test bolus
3D-MRA breathold with double dose (35cc)

INFERIOR VENA CAVA

Axial: T(2) Balanced GE
Coronal: T(2) Balanced GE

2-D axial MRA to cover IVC (5 slices/breathold, MIP together)

Breathold no contrast mask

Post Gad: Timing run w/ 30sec scan delay, 5cc test bolus
3D-MRA breathold with double dose (35ml)

THORACIC AORTA

Use Cardiac Table gating
Axial T(1) SE gated
ParaSagittal T(1) SE gated (Candy Cane)

Breathold no contrast mask

Axial: Timing run in Aortic Arch, 2cc test bolus

Post Gad: ParaSagittal 3D MRA of Aorta

When doing parasagittals be sure to change orientation to coronal before angled

AORTIC ARCH & GREAT VESSELS

Axial: T(2) Balanced GE to include ascending and descending aorta

Post Gad: ParaSagittal CareBolus with 20cc

ABDOMINAL AORTA

Axial: T(1) Steady State GE
Coronal T(1) Steady State GE

Post Gad: Coronal 3D CareBolus with 20cc

PERIPHERAL LOWER EXTREMITY RUNOFF

Localizer from renal to ankle

Do visual prep
OR
Do timing bolus

Post Gad: Coronal 2D TOF MRA
1st phase – 2.0cc/sec for 20cc through femurs
2nd phase – 1.0cc/sec for 30cc through ankle

do scan from renal to ankle then back up from ankle to renals

CARDIAC (MYOCARDIAL VIABLITY)

Axial: T(1) Ultrafast SE black blood
CINE Balanced GE
2D TOF

Perfusion

BREAST IMAGING

BREAST (ROUTINE)

Axial	STIR with body coil	
Axial	T(1) SE	
	T(2) FatSat	
Post Gad:	Axial	3D dynamic
Delayed:	Axial	3D (1024x1024)

BREAST (IMPLANTS)

Axial	T(2) TIRM
	T(2) FatSat
	T(2) WaterSupressed
	T(2) TIRM FatSat
Sagittal	T(2) TIRM
	T(2) FatSat
	T(2) WaterSupressed
	T(2) TIRM FatSat

Gadolinium Advisory Statement

Patients over age 60 OR with risk factors for renal disease (ie, dialysis, renal transplant, single kidney, kidney surgery, kidney cancer, diabetes or hypertension requiring medical therapy) are required to have their serum creatinine level measured before the contrast-enhanced MR examination

Gadolinium contrast material has been found to be associated with the condition Nonspecific Systemic Fibrosis (NSF). The usage of Gadolinium contrast is recommended in patients with adequate renal function. The following recommendations are suggested by Akron Radiology Inc. based on the American College of Radiology Guidelines:

GFR > 60: Acceptable to use Gad contrast material.

GFR > 30: Acceptable to use Gad contrast material if clinically necessary.

GFR <30: The usage of Gad contrast only indicated in cases of medical necessity

All deviations from the accepted guidelines are to be approved by the attending Radiologist.

If Gad contrast is to be used in patients with poor renal function or on dialysis, appropriate arrangements should be made to schedule dialysis within 2 hours after the injection of Gad contrast material.

Renal Disease Severity	Guideline
eGFR $\geq$ 60 mL/min/m^2	GBCA can be administered as indicated.
eGFR 30–59 mL/min/m^2	Weight-based dose of GBCA (0.2 mL/kg) can be administered, with maximal dose of 20 mL allowed within 24 hours.
eGFR $<$ 30 mL/min/m^2	GBCA cannot be administered, except in cases of medical necessity. Informed patient consent is required. Nephrology consultation is required, preferentially before requested examination is performed. Hemodialysis should be considered; for patients already receiving dialysis treatment, dialysis should be performed promptly after the GBCA injection.

References:
Incidence of Nephrogenic Systemic Fibrosis after Adoption of Restrictive Gadolinium-based Contrast Agent Guidelines. Radiology July 2011 260:105-111.
ACR Manual on Contrast Media. Version 9 2013.

Ver 7.0 Revisions

Updated Routine Brain
- diffusions
- Sagittal sequences
- CSF flow

Updated Routine L/S with axial T(2)

Updated all MS
- Knee add pd fatsat
- Shoulder add t2 cor fatsat
- Ankle change t1 coronal to pd fatsat
- Elbow change t2 axial to fatsat
- Hip change t2 axial to fatsat
- Hip arthrogram no t2
- Revamp forearm

Abd
- added in/out phase as routine
- added t2 thick slab rotations to MRCP

MRA
- Peripheral lower extremity runoff

Cardiac

7.1 Revisions:

Tech update

IAC FatSat

Abd Ao

8.0 Revisions

Added Brain Bleed
- Sacrum
- Breast
- Extremity infection

Sagittal STIR spines

Arm raised shoulder arthrogram

Updated liver to dynamic
- renal with T(2) FatSat
- MRCP with trigger 3D, Ultrafast SE coronal, and Liver
- Dynamic pancreas

Added MRA Portal Vein

Version 9.0 Revisions
Gad Advisory Statement

Version 10.0 Revisions
New MSK protocols
- PDFS in place of T(2) on almost all sequences

Rtn use of Gad for infection

Version 11.0 Revisions
Neuro update from Sept meeting
- Rtn Post Gd brain in two planes
- Update orbits

New MSK protocols
- Quad muscle
- Adductor rupture (hernia)
- Forearm

Update MSK
- Elbow
- Ankle
- Extremity mass & infection add PD FatSat, best plane
- Hips

Abd update
- Uterine Ablation protocol
- Add pelvimetry

MRA carotid update

Version 11.1 Revisions
Neuro update from Sept meeting
- Add rtn BOLD
- Dynamic Sella
- Add GRE to T spine
- Update no gad for post op C spine
- Did not: add rtn brain coronal, pre T1 axial on post gad brains, seizure MPRAGE

MSK
- Update latest shoulder
- Hips with small FOV unilateral and axial oblique added
- New SI jnt post gad
- Foot/ankle orientation change and add Neuroma & infection
- Move brachial plexus to msk
- Add pectoralis major
- Add hand and digit
- Add bony pelvis
- Add calf

Version 11.3 Revisions

Neuro

- Rtn brain on IAC studies
- Sagittal post gad on initial pituitary
- Post op lumbar T(1) over surgical levels only
- Orbits to include rtn brain

MSK

- Revised Athletic Pubalgia

Abd

- Add Placenta
- Dynamic Renal
- Gad adrenals
- High T(2) liver hemangioma

Version 11.4 Rev

Neuro

- Add FLAIR axials to seizures
- Sella T(1) post dynamic coronal
- Post op lumbar entire spine – go figure

Abd

- EOVIST

Version 11.5 Rev

Change:

- HASTE – Ultrafast SE
- THRIVE – Ultrafast Spoiled GE
- TRUFI – Balanced GE
- FLASH – Spoiled GE
- FISP – Steady State GE

Abd

- Add coronal STIR to Renal

Version 11.5b Rev

Neuro

- Add Pre Gad T(1) axials to all brains
- Axial MPRAGE (3D IR) to seizures
- Add Cor T(2) FatSat to neck

MSK

- Change pelvis to T(2) FatSat

Abd

- Update dynamic timing in abd

Version 13 Rev (6/4/2013)

Neuro

All pituitary exams include dynamic post contrast imaging
Cervical spine axial FSE T(2) included on routine

Abd

Rectal MR for staging added
Liver Eovist limited to hepatoma, cirrhosis or mets
Liver Eovist – 20 min imaging includes coronal
Adrenal – post contrast imaging deleted
Add Susupected appendicitis in preganancy protocol

Gadolinium advisory updated

Version 2013b (9/2013)

Updated numbering scheme

MSK

Proton/Spin density sequence performed at TE of 60
Changed SI joint protocol
Thighs
Legs

Abd

Diffusion weighted imaging with b value 0-50 and 800-1000 added for most abdominal sequences
Pelvic for endometriosis – T1 is now with fat sat
Rectal – angle axial perpendicular to long axis of rectum at level of tumor
Prostate

MRA

Added optional post-gad MRV head

Version 2014

Neuro

Specified field of view for Cervical and Lumbar
Add Axial GRE to Brain for seizure
Limit Brain for seizure to patients <70 yo, otherwise perform routine Brain

MSK

For Infection - SE T(1) all three planes in small joints

Abd

Updated Pelvis for UAE

Version 2015

Neuro

Updated Entire Spine Survey

MSK

Updated Foot (Infection)

Version 2015b

Neuro

Seizure protocol only for refractory seizure or specific requests for protocol

IAC – coronal T1 post Gad now performed without fat sat (ACR accreditation requirements)

Orbits - Add Pre Gad axial T1 and T2 non-fat sat orbits and coronal STIR pre contrast (ACR)

MSK

Knee – add sagittal T(2) (ACR)

Ankle/Foot – add T(1) coronal (ACR)

SI joints use Gad for all

Shoulder – add coronal T(1)

Abd

Renal – change axial T(1) to In/Out phase GRE (ACR

Add MR Urogram

Pancreas – If cyst known or detected, then add thin slice MRCP sequence to determine if cyst communicates to pancreatic duct

MRCP now includes dynamic multiphase post Gad T(1) of liver

Enterography performed in prone position. Add optional IM glucagon

Rectal protocol changed to Rectal or Cervix for staging

Prostate – add axial T(1) whole pelvis (ACR)

Version 2015c

Neuro

Brain for seizures – remove axial 3D, add coronal T(1)

Orbits – Remove axial T(2)

Abd

MRCP back to non-contrast

Add Abdomen – nonspecific (abdominal pain, other)

Other

Updated Gadolinium advisory statement regarding patients at risk requiring creatinine determination

Version 2015d

Neuro – Brain with contrast - delete coronal T(1)

MSK

Add T(1)FatSat

MRA

MR Venogram Head – use gadolinium on all except when patient undergoing MRA during same exam

Added statement about Ablovar (blood pool agent)

Version 2016a

Neuro - L spine – axials done in blocks angled through discs, but straight can be included especially if entire canal was not included in angled blocks

Abd - Pelvis for soft tissues – post contrast sequence to be performed without fat suppression

Pelvis for rectal CA – tech please make attempt to get colonoscopy report

Breast -Updated sequences

Version 2016b

MRI Brain for seizure for patients with first seizure or 70 y.o.– perform routine brain without contrast or with/without contrast if requested

Version 2017

Add Total Body for Multiple Myeloma

Reverse policy regarding seizure as noted in 2016b

Version 2018

Updated abdomen/pelvis in pregnancy for suspected appendicitis