# BODY MRI PROTOCOLS

**Updated**
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## MRA/MRV

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Abdomen

**Limited abdomen and pelvis**
(cancer surveillance, non-specific clinical history)
1. Localizer
2. asset calibration
3. axial in-phase/out-of-phase pelvis
4. axial T2 FS SSFSE pelvis
5. axial 3D LAVA pre- pelvis
6. axial in-phase/out-of-phase abdomen
7. axial T2 SSFSE abdomen
8. coronal T2 SSFSE abdomen
9. axial 3D LAVA/FAME pre- abdomen
10. axial 3D arterial FAME/VIBE abdomen
11. axial 3D venous FAME/VIBE abdomen
12. axial 3D FAME/VIBE delayed pelvis

**Basic (limited) abdomen**
(Abscess, non-specific clinical history, non-organ evaluation)
1. Localizer
2. asset calibration
3. Coronal SSFSE T2
4. Axial FRE T2 respiratory triggered /or FRFSE-XL T2 breath hold
5. Axial T2 w/ FS SSFSE
6. Axial in-phase/out-of-phase
7. Axial / coronal 3D lava pre-
8. Axial 3D FAME/VIBE post arterial
9. Coronal 3D FAME/VIBE post delayed

**Basic (limited) pelvis**
(Abscess, non-specific clinical history)
1. Localizer
2. asset calibration
3. axial in-phase/out-of-phase pelvis
4. axial T2 w/ FS SSFSE pelvis
5. axial 3D FAME/VIBE pre- pelvis
6. axial 3D FAME/VIBE delayed pelvis
7. coronal 3D FAME/VIBE delayed pelvis

**Dynamic Liver** *(HCC, cholangiocarcinoma, lesion characterization)*
1. Axial T1 I/O phase
2. Axial T2 BH FRFSE
3. Axial T2 BH FRFSE w/ FS
4. Coronal T2 SSFSE
5. Axial FAME/VIBE w/FS pre Gad
6. Axial FAME/VIBE w/FS post Gad at 30 seconds, 1 & 3 minutes
   *subtraction images for each post gado acquisition
7. Coronal FAME/VIBE w/FS post Gad at 5 minutes
8. Diffusion axial x 2. b value of 50 and 750 with ADC maps

EOVIST LIVER (r/o mets, if FNH/adenoma suspected, biliary leaks)
1. Axial T2 SSFSE
2. Coronal T2 SSFSE
3. Axial T1 Dual ECHO –In and Out of Phase
4. Axial FAME/VIBE w/FS pre Gad
5. Axial FAME/VIBE w/FS post Gad:
   2 phase arterial (Dynamic)
   1 & 3 min delayed
   *need subtractions for all
6. Coronal FAME/VIBE 4min delayed
7. Axial FAME/VIBE 5 min delayed
8. Axial and Coronal FAME/VIBE 20 min delayed

MRCP
   Patient Prep: NPO 4 hours prior
   Arrive 20-30 minutes early for 150-300 ml of PO pineapple juice
1. Axial T1 I/O phase
2. Axial T2 SSFSE
3. Coronal T2 SSFSE
4. Thick Slab SSFSE – 4 oblique planes through panc/CBD/GB, 40mm thick
5. Coronal 3D Volume Respiratory triggered MRCP*
   a. Thin coronal MIP images created from this (1.6/0.8)
   b. Thin axial MIP images created from this (1.6/0.8)
   *Do breath hold acquisition if the respiratory trigger is poor*

If secretin exam:
Secretin: adults: 0.2µg/kg IV slowly over 1 minute
           pediatric: 0.2 µg/kg (maximum dose, 16 µg)
           Administered by angio RN- IV push
6. Thick slab SSFSE through plane of pancreatic duct every minute for 10 minutes
   (stacked)

Liver for Hemochromatosis
**Must be done on 1.5 T magnet**

1. Axial GRE 90 degree flip TE 4.0
2. Axial GRE 20 degree flip TE 4.0
3. Axial GRE 20 degree flip TE 9.0
4. Axial GRE 20 degree flip TE 14.0
5. Axial GRE 20 degree flip TE 21.0

Pancreas

Patient Prep: NPO for 4 hours,

If MRCP is NOT requested, give 750cc water PO starting 60 min prior to exam

1. Axial T2 SSFSE
2. Coronal T2 SSFSE
3. Axial T1 I/O phase
4. Axial T2 FSE w/ FS
5. Axial FAME/VIBE w/FS pre Gad
6. Axial FAME/VIBE w/FS post Gad at: 35 seconds, 70 seconds, 3 minutes
   Slice thickness 3mm
7. Coronal FAME/VIBE w/FS post Gad at 3 minutes

Adrenal

If indication is adrenal adenoma, call rad to check after in-phase/opposed-phase series

1. Coronal T2 SSFSE Coronal: diaphragm to aortic bifurcation
2. Axial T1 GRE (In & Out of Phase) adrenals: 3-4mm slice thickness
3. Coronal T1 GRE (In & Out of Phase) adrenals: 3-4mm slice thickness
4. Axial T2 FSE with FS: diaphragm to aortic bifurcation
5. Axial FAME/VIBE w/FS pre Gad: diaphragm to aortic bifurcation
6. Axial FAME/VIBE w/FS post Gad at 35s, 70s: diaphragm to bifurcation
7. Coronal FAME/VIBE w/FS post Gad at 3 minutes

Renal for Mass

Field of view limited to kidneys

1. Axial T1 I/O phase
2. Coronal T2 SSFSE
3. Axial T2 SSFSE
4. Axial T2 SSFSE w/FS
5. Axial FAME/VIBE pre Gad
6. Sagittal FAME/VIBE of each kidney pre Gad
7. Coronal FAME/VIBE pre Gad
8. Coronal FAME/VIBE post Gad at 25/90 seconds
9. Sagittal FAME/VIBE post Gad of each kidney
10. Axial FAME/VIBE post Gad
    ** if the patient cannot receive gadolinium, please obtain:
11. Diffusion axial x 2. b value of 50 and 750 and ADC maps
**MR Urogram**


Patient prep: Arrive 1 hour prior to get IVF
- Empty bladder prior to getting on table
  - Adult: 500cc NS bolus IMMEDIATELY BEFORE scan
  - Pediatric: weight based IVF per article pg S4:
    - 4ml/kg/hr for 1st 10 kg
    - 2ml/kg/hr next 10 kg
    - 1ml/kg/hr for each kg above 20 kg

Adults: Arrive 1 prior to angio for IV placement, fluids, possible catheter placement (optional). **Lasix dose: 20-40 mg slow IV push**

Pediatrics: Requires Pain Free and catheter (can administer Lasix).
**Lasix dose: 1 mg/kg (up to max dose 20mg) slow IV push.**

1. Coronal T2 SSFSE Abd and pelvis
2. Axial FS T1 Abd and pelvis
3. Axial T2 FSE Abd and pelvis
4. Axial T2 FSE w/FS Abd and pelvis
5. Coronal T2 FSE w/FS Abd and pelvis

**POST LASIX:**
1. Coronal T2 SSFSE Thin section (1 mm) respiratory triggered Kidneys/Ureters
   *Need 3D reconstructions.
2. Coronal LAVA/FAME pre Gad

**POST GAD:**
3. Dynamic 3-D GRE in coronal oblique plane to include kidneys and bladder
   a. 2 mm slice thickness
   b. Dynamic scanning: arterial phase (~30 seconds), 1 min (PVP), 90-100 sec (nephrographic), ~8 minutes (excretory phase)
   c. Automatic MIP images of each volume acquired.
   *** have rad check***
4. Coronal FAME/VIBE post Gad 8 min (need to see ureters to bladder)
5. Sag 10 min FAME/VIBE post Gad of each kidney

**Enterography**

*Patient prep: Volumen, 3 bottles, 90 minutes prior to study.*

*Glucagon 1 mg IM after thick slab coronals & FIESTA.*
1. Thick Slab T2 Coronals (40mm FOV, 4-5 stations anterior to posterior to cover all small bowel, 5 images per station)
2. Coronal T2 FIESTA
3. Coronal T2 SSFSE BH
4. Axial T2 BH w and w/o FS
5. Axial LAVA/FAME pre
6. Coronal FAME/VIBE pre
7. Coronal FAME/VIBE post Gad at 35 and 70 seconds
8. Axial FAME/VIBE post Gad
**Renal MRA**
Use ablavar
1. Coronal T2 SSFSE- to determine anatomy and location of kidneys
2. Axial FSE T2 BH-fat sat
3. Axial FIESTA (gated multiphase)
4. Coronal FIESTA
5. Optional 3D TOF (if can’t get Gad)
6. Coronal pre Gad MRA
7. Coronal MRA post Gad- 3D acquisition arterial phase(s)
   a. Reformat into thin axial and coronals
   b. 3D reformats of arterial phase
8. Axial FAME/VIBE w/FS post Gad
9. Coronal FAME/VIBE w/FS at 5 minutes
10. 3D Phase contrast (only if can’t get Gad)

**Mesenteric MRA**
Use ablavar
1. Coronal T2 SSFSE
2. Axial T2 BH w/fat sat
3. Axial FIESTA (gated multiphase)
4. FIESTA -Sagittal
5. Optional 3D TOF (if can’t get Gad) (SMA and celiac)
6. Sagittal pre Gad MRA
7. Sagittal MRA post Gad- 3D acquisition arterial phase(s)
   a. Reformat into thin axial and sagittals
   b. 3D reformats of arterial phase
8. Axial FMPSGPR w/FS post Gad

**Aorta (Chest/Abd/Pelvis)**
Use ablavar
If patient cannot get gado, must be done on a 3T
1. Axial DIR-Peripheral Gated
2. Axial FIESTA-gated
3. Sagittal-Oblique FIESTA-gated
4. MRA Dry Run
5. MRA w/Gado- Sagittal Oblique (Candy-Cane) 3D acquisition
   a. Reformat into thin axials
   b. 3D reformats of arterial phase
6. Axial FMPSGPR w/FS post Gado
Pelvis

Anal fistula
Should be performed on 3T
1. Sagittal T2 SSFSE (Full FOV, 2.5mm/gap 0)
   *Use to establish oblique planes -axial and coronal to long axis of anal canal; see images below. MD to check planes if unsure.

Smaller FOV 26 cm:
2. Obl axial T1 FSE pre (4mm/gap 0.8)
3. Obl axial T2 fat sat FSE (4mm/gap 0.8)
4. Obl axial T2 FSE (4mm/gap 0.8)
5. Obl coronal T2 fat sat FSE (4mm/gap 0.8)
6. Obl coronal T2 FSE (4mm/gap 0.8)

Post gado:
7. Obl axial FAME/VIBE (4mm/gap 0.8)
8. Obl coronal FAME/VIBE (4mm/gap 0.8)

MRV Pelvis DVT
Use ablar
1. 2d TOF – reformat into 3D image
2. 3D SPGR pre gad
3. 3D MRV (venography) post gad: Scan in 3 phases – 2 min, 3min, 4 min post
   a. Reformat each phase into thin axials and sagittals
   b. 3D Reformats of each phase
4. Axial FAME/VIBE T1FS post gad

Female Pelvis (adenomyosis, fibroids, adnexa)
Planes in relation to uterus for uterine pathology, otherwise in relation to pelvis
For uterine pathology:

1. Coronal SSFSE Abd and pelvis
2. Axial T1 whole pelvis
3. Axial T1 FSE Fat Sat (with superior and inferior sat bands) – small FOV
4. Axial T2 FSE -small FOV
5. Axial T2 FSE w/FS- small FOV
6. Sagittal T2 (uterine evaluation ) small FOV
7. Sagittal T2 with Fat Sat

If indicated, use gadolinium and add:
8. Axial FSPGR w/FS
9. 3D T1 FS post Gad in 3 planes: Coronal, Sagittal, Axial

Female Pelvis Mullerian
Planes for small field of view axial/coronal images in relation to uterus:
1. Axial T2 FSE FS full FOV
2. Axial T1 FSE full FOV
3. Sagittal T2 FSE small FOV 4mm/slice
4. Axial T2 FSE (in relation to the uterus) small FOV 4mm/slice
5. Coronal T2 FSE (in relation to the uterus) small FOV 4mm/slice
6. Coronal SSFSE/HASTE/TruFISP full FOV coronal to include kidneys 7mm/slice

**Cervical cancer staging**

Planes for small field of view axial images in relation to cervix:

1. Axial T1 FSE upper abdomen and pelvis
2. Axial T2 FSE FS full FOV pelvis
3. Sagittal T2 FSE pelvis small FOV pelvis
4. Axial oblique T2 FSE small FOV pelvis (in relation to the cervix)

AJR 2007; 188:1577–1587
Endometrial cancer staging
Planes for small field of view axial/coronal images in relation to uterus:

1. Axial T1 FSE upper abdomen and pelvis
2. Axial T2 FSE FS full FOV pelvis
3. Sagittal T2 FSE small FOV
4. Axial oblique T2 FSE (short axis of the uterus) small FOV
5. Sagittal and Axial oblique FS pre
6. Post gad: 3D Gradient echo fat sat small FOV:
   a. Sagittal: 1, 3, 5 min
   b. Axial oblique (short axis of the uterus) 4 min

AJR 2007; 188:1577–1587

Female Pelvis Urethral protocol
1. Coronal SSFSE: wide FOV to include kidneys
2. 3 plane T2 Fat Sat- 18-24cm FOV to be centered on the urethra
3. Axial T1 Fat Sat-18-24 small FOV
If indicated (requested by the MD for infection, inflammation, or malignancy):
4. Pre Gad T1FS
5. 3D T1 FS post Gad in 3 planes: Coronal, Sagittal, Axial

Prostate cancer staging (For staging or XRT planning *no diffusion)
1. Axial T1 whole pelvis
2. Axial T1 small FOV
3. T2 FSE 3mm small FOV
   a. axial oblique
   b. sagittal
   c. coronal oblique
4. Axial 3D T2
**Dynamic Prostate/Surveillance** (Elevated PSA, negative biopsy)

**MUST BE ON 3T/phased array body coil**

1. Axial T1 FSE TR/TE 650/10 small FOV(20cm) 3mm/1mm MATRIX 320
2. Axial T2 small FOV(20cm) 3mm/1mm MATRIX 320
3. Sagittal T2 small FOV FSE 3mm/1mm
4. Coronal T2 5000/93 Echo train 13 small FOV(20cm) 3mm/1mm MATRIX 320
5. DWI axial TR/TE 6000/78 flip angle 90, nex 6, b-values 0 and 1000, matrix 128x92 FOV 35cm x35cm 3mm/1mm to cover entire prostate and seminal vesicles. Need ADC maps.

Post gadolinium:

1. Axial post gad: rapid dynamic contrast enhanced
   Slice thickness 4.0/0.0, sequential 16 axial slices, 20 phase acquisition
   FOV 22

**Pregnant R/O Appendicitis**

1. Coronal T2 SSFSE
2. Axial T2 SSFSE
3. Sagittal T2 SSFSE
4. Coronal T2 Breath Hold with Fat Sat
5. Axial T2 Breath Hold with Fat Sat
6. Coronal FIESTA
7. Axial FIESTA (optional – do if ? kidney stone)

**Defecography**

1. Axial T2 SSFSE
2. Sagittal T2 SSFSE to obtain midline
3. Sagittal FIESTA at Rest
4. Sagittal FIESTA with Kegel
5. Sagittal FIESTA with minimal straining
6. Sagittal FIESTA with moderate straining
7. Sagittal FIESTA with maximum straining
8. Sagittal FIESTA with defecation

**Fetal MRI**

1. Axial T2 SSFSE
2. Sagittal T2 SSFSE
3. Coronal T2 SSFSE
4. Axial FIESTA
5. Coronal FIESTA
6. Sagittal FIESTA

Can add T1s for blood, esp in brain.
Rectal cancer staging
3T during day preferably to be monitored by a Radiologist
Planes for small field of view axial/coronal images in relation to rectum

1. Sagittal large FOV T2 SSFSE for planning of sequences: 5mm/slice
2. T1 TSE axial (short echo train 3-5) pelvis up to the aortic bifurcation: 5mm/slice.
3. Axial T2 FSE full FOV pelvis 5mm/slice
4. Coronal oblique T2 small FOV: 3mm/slice
   Administer rectal gel, then:
5. Coronal oblique T2 small FOV: 3mm/slice
6. Axial oblique T2 small FOV: 3mm/slice
7. Axial oblique T2 small FOV: 3mm/slice (parallel to the long axis of the anal canal to evaluate for sphincter involvement)
8. Sagittal T2 small FOV 3mm/slice
   Post gadolinium:
9. Coronal oblique FAME/VIBE small FOV: 3mm/slice
10. Oblique axial FAME/VIBE small FOV: 3mm/slice
11. Sagittal FAME/VIBE small FOV: 3mm/slice

MR technologist: if you are uncertain about the oblique axial and coronals, or if the tumor involves the rectum as it curves, call MD to help select the best imaging planes.