Abdomen

**No post contrast subtraction images unless specified in protocol**

**Limited abdomen and pelvis**
(cancer surveillance, non-specific clinical history)

http://www.enhancedcme.com/assets/html/ge.html

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 pre- abdomen
10. axial 3D arterial LAVA abdomen
11. axial 3D venous LAVA abdomen
12. axial 3D LAVA delayed pelvis

**Basic abdomen**

http://www.enhancedcme.com/assets/html/ge.html

1. Localizer
2. asset calibration
3. Coronal SSFSE T2
4. Axial FRE T2 respiratory triggered /or FRFSE-XL T2 breath hold
5. Axial in-phase/out-of-phase
7. Axial / coronal 3D lava pre-
8. Axial 3D LAVA post dynamic
9. Coronal 3D LAVA post delayed

**Liver (40 min)**

1. Axial T1 I/O phase
2. Axial T2 BH FRFSE
3. Axial T2 BH FRFSE w/ FS
4. Coronal T2 SSFSE
5. Axial LAVA/FAME w/FS pre Gad
6. Axial LAVA/FAME w/FS post Gad at 30 seconds, 1 & 3 minutes
   
   Need subtraction images for each post gado acquisition
7. Coronal LAVA/FAME w/FS post Gad at 5 minutes
8. Diffusion axial x 2. b value of 50 and 750.
EOVIST LIVER (40 min)

1. SSFSE-axial
2. SSFSE-Coronal
3. Dual ECHO – In and Out of Phase: Axial
4. LAVA pre-axial

**GAD**
5. LAVA: 2 phase injection: (Dynamic)
   a. Need subtraction images
6. LAVA: Axial 70sec delayed
   a. Need subtraction images
7. LAVA: Axial 3min delayed
   a. Need subtraction images
8. LAVA: Coronal 4min delayed
9. LAVA: Axial 5 min delayed
10. LAVA: Axial and Coronal 20 min delayed

MRCP (25 min)

NPO 4 hours prior
Arrive 20-30 minutes early for 150-300 ml of po pineapple juice or Gastromark

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 (optional) adults: 0.2μg/kg IV slowly over 1 minute
   pediatric: 0.2 μg/kg (maximum dose, 16 μg)
Administer secretin by angio RN- IV push

6. Thick slab SSFSE through plane of pancreatic duct every minute for 10 minutes (stacked)
Liver for Hemochromatosis
**Should 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 (40 min)
Patient Prep: NPO for 4 hours,
If MRCP is NOT requested, give pat 750cc of water starting 60 min prior to exam
1. SSFSE Axial
2. SSFSE Coronal
3. T1 I/O phase
4. Axial T2 FSE w/ FS
5. Axial LAVA/FAME w/FS pre Gad
6. Axial LAVA/FAME w/FS post Gad x/x at 35 seconds, 70 seconds, 3 minutes
7. Coronal LAVA/FAME w/FS post Gad at 3 minutes

Adrenal: (40 min)
Coverage - diaphragm to aortic bifurcation
If clinical question is adrenal adenoma, then call rad to check after in-phase/opposed-phase series
1. SSFSE Coronal –diaphragm to aortic bifurcation
2. T1 GRE (In & Out of Phase) : Axial (adrenals) 3-4mm slice thickness
3. T1 GRE (In & Out of Phase) : Coronal (adrenals) 3-4mm slice thickness
4. T2 FSE with FS: axial -diaphragm to aortic bifurcation
5. Axial LAVA/FAME w/FS pre Gad diaphragm to aortic bifurcation
6. Axial LAVA/FAME w/FS post Gad at 35s, 70s (diaphragm to bifurcation)
7. Coronal LAVA/FAME w/FS post Gad at 3 minutes

Renal for Mass (60 min)
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 LAVA pre Gad
6. Sagittal LAVA of each kidney pre Gad
7. Coronal LAVA pre Gad
8. Coronal LAVA post Gad at 25/90 seconds
9. Sagittal LAVA post Gad of each kidney
10. Axial LAVA post Gad
   ** if the patient cannot receive gadolinium, please obtain:
11. Diffusion axial x 2. b value of 50 and 750.

**MR Urogram**

Have patient arrive 1 hour prior to get IVF

*Patient prep:* 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 1st 10 kg
   2ml/kg/hr next 10 kg
   1ml/kg/hr for each kg above 20 kg

Adults: patient to arrive 1 prior to angio in RR for IV placement, hang fluids, possible catheter placement (optional).
   **Lasix dose: 20-40 mg slow IV push**
   **Laxis dose: 1 mg/kg (up to max dose 20mg) slow IV push.**

1. SSFSE: Coronal 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

**LASIX**
1. Coronal T2 SSFSE Thin section (1 mm) respiratory triggered Kidneys/Ureters (MRCP type, for stagnant fluid, i.e. obstruction) with 3D reconstruction.
2. Coronal LAVA pre Gad
3. Dynamic 3-D GRE in coronal oblique plane to include kidneys and bladder, 2 mm slice thickness. Automatic MIP images of each volume acquired. Do dynamic scanning with timing of scan acquisition: arterial phase (~30 seconds), Portal venous phase (~60 sec), nephrographic (~100 sec), excretory phase (~8 minutes).
   *** have rad check***
4. Coronal LAVA post Gad in excretory phase (~ 8 min), (need to see ureters to bladder) have rad check. 3D recon.
5. Sag 10 min LAVA post Gd of each kidney

**Use Ablavar for ALL MRAs**
**Renal MRA (60 min)**

1. Coronal SSFSE- to determine anatomy and location of kidneys
2. Axial FrFSE T2 BH-fat sat
3. FIESTA –Axial (gated multiphase)
4. FIESTA -Coronal
5. Optional 3D TOF (if can’t get Gad)
6. Dry Run MRA
7. Renal MRA w/Gado- Coronal 3D acquisition
   a. Reformat into thin axial and coronals
8. Axial FMPSPGR w/FS post Gad
9. Coronal FMPSPGR w/FS at 5 minutes
10. 3D Phase contrast

**Aorta (Chest/Abd/Pelvis) – (60 min)**

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
6. Axial FMPSPGR w/FS post Gado

**Enterography (60 min)**

Volumen, 3 bottles, 90 minutes prior to study, need to give glucagon to slow peristalsis, give 1 mg IM after thick slab coronals.

1. Thick Slab Coronals (MRCP like, 40mm FOV, 4-5 stations anterior to posterior to cover all small bowel, 5 images per station [to view, sort images by table position])
2. Coronal 2D FIESTA
3. Coronal T2 SSFSE BH
4. Axial T2 BH w and w/o FS
5. Axial LAVA pre
6. Coronal LAVA pre
7. Coronal LAVA post Gad at 35 and 70 seconds
8. Axial LAVA post Gad

**Pelvis**
**Anal fistula protocol**

Preferably on 3T  
Sag T2 FRFSE (Full FOV, 2.5mm/gap 0)  
   *Use to establish oblique planes -axial and coronal to long axis of anal canal. MD to check planes if unsure.*  
Smaller FOV 26 cm:  
Obl axial T1 FSE pre (4mm/gap 0.8)  
Obl axial T2 fat sat FRFSE (4mm/gap 0.8)  
Obl axial T2 FRFSE (4mm/gap 0.8)  
Obl coronal T2 fat sat FRFSE (4mm/gap 0.8)  
Obl axial fat sat FSPGR post (4mm/gap 0.8)  
Obl coronal fat sat FSPGR post (4mm/gap 0.8)

**MRV Pelvis DVT/May Thurner (occult stroke with PFO)**

*Use ablavar, Do not use TRICKS*  
1. 2d TOF  
2. SPRGR pre- post gad  
3. 3D MRV (venography): Scan in 3 phases, the first after a 120sec fixed time delay.  
   a. Reformat each phase into thin axials and sagittals  
4. Axial LAVA T1FS post gado

**Female Pelvis (60 min slot for GAD, NO Gad 40min)**

Planes in relation to uterus for uterine pathology, otherwise in relation to pelvis  
For uterine pathology:
1. SSFSE Coronal 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-small FOV
5. Sagittal T2 (uterine evaluation) small FOV
6. Sagittal T2 with Fat Sat
7. Axial T2 w/FS- small FOV

If question malignancy, add:

8. Axial FSPGR w/FS
9. Axial FSPGR w/FS post Gad
10. Coronal FSPGR w/FS post Gad
11. Sagittal FSPGR w/FS post Gad

**Female Pelvis Mullerian protocol:**
*Planes for small field of view images in relation to uterus as per above image.*

1. T2 FSE axial FS full FOV
2. T1 FSE axial full FOV
3. T2 FSE sagittal (in relation to the uterus) small FOV 4mm/slice
4. T2 FSE axial (in relation to the uterus) small FOV 4mm/slice
5. T2 FSE coronal (in relation to the uterus) small FOV 4mm/slice
6. SSFSE/HASTE/TruFISP coronal to include kidneys 7mm/slice (abd/pelvis same field of view as in enterography)

**Female Pelvis Urethral protocol: 60 min**

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
4. Gad if requested by the MD for infection, inflammation, or malignancy
   a. Axial T1FS in 3 planes

**Cervical cancer staging protocol:**

T1 FSE axial upper abdomen and pelvis
T2 FSE FS axial full FOV pelvis
T2 FSE saggital pelvis small FOV pelvis
T2 FSE axial oblique small FOV pelvis (short axis of the cervix)

Radiographics 2007 AJR 2007; 188:1577–1587

**Endometrial cancer staging protocol:**

1. T1 FSE axial upper abdomen and pelvis
2. T2 FSE FS full FOV axial pelvis
3. T2 FSE saggital small FOV
4. T2 FSA axial oblique (short axis of the uterus) small FOV
5. T1 weighted 3D Gradient echo small FOV:
   a. saggital at 0,1,3,5min
   b. axial (short axis) 4min

Radiographics 2007 AJR 2007; 188:1577–1587

**Prostate (40 min)- 2 separate protocols**

1. For staging or XRT planning (*no diffusion*)
   1. Axial T1 whole pelvis
   2. Axial T1
   3. T2 FSE 3mm small FOV
      a. axial oblique
      b. sagittal
      c. coronal oblique
   4. Axial 3D T2

2. Prostate with contrast and diffusion (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. T2 axial small FOV(20cm) 3mm/1mm MATRIX 320
3. T2 sagittal small FOV FSE 3mm/1mm
4. T2 coronal 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

Contrast sequences
1. axial post contrast – rapid dynamic contrast enhanced
   Slice thickness 4.0/0.0, sequential 16 axial slices, 20 phase acquisition
   FOV 22


Pregnant R/O Appendicitis (40 min)

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

Defecography (40 min)

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

Fetal MRI (60 min)

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 protocol
3T during day preferably to be monitored by a Radiologist

1. Sagittal large FOV T2 SSFSE for overview and planning of subsequent sequences 5mm/slice
2. T1 TSE axial (with short echo train of 3-5) to look for lymph nodes pelvis up to the aortic bifurcation 5mm/slice.
3. T2 tumor localization with T2 FSE axial full FOV pelvis 5mm/slice
4. T2 small FOV perpendicular to the long axis of the rectum 3mm/slice
5. T2 small FOV perpendicular to the long axis of the rectum 3mm/slice after rectal gel
6. T2 small FOV coronal (parallel) to the long axis of the rectum 3mm/slice
7. T2 small FOV coronal (parallel) to the long axis of the anal canal 3mm/slice to evaluate for sphincter involvement
8. T2 Sagittal small FOV 3mm/slice
Post iv contrast:
9. T1 SPGR axial small FOV perpendicular to the long axis of the rectum 3mm/slice
10. T1 SPGR coronal small FOV parallel to the long axis of the rectum 3mm/slice
11. T1 SPGR sagittal 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.