Ultrasound Protocols and Guidelines
(version 11/2016)
**IMPORTANT**

**********When unable to visualize an organ/vessel you must document the area by annotating the image with “unable to visualize.”**********

Example. Pancreas area, Aorta area

*** Color and spectral doppler images to prove artifact. Examples: GB sludge, biliary dilatation any cystic structures

**Fetal Heartbeat (only) sonography**
Indication: Used only to document fetal viability during a pelvic ultrasound.

**Early OB…New guidelines**
If NO FHB at 7 weeks ….Then it is safe to call it a fetal demise.

**Carotid exam**
**A Grey scale transverse image of the vessel is required to demonstrate area of excessive plaque.**

**Thyroid**
Perform the exam before measuring the nodules. Measure the nodules at the end of the exam. Measure the largest or suspicious nodules on each side (no more than three nodules). Measure in three dimensions (AP and length on sagittal view, width on transverse view. If there are two dominant nodules in a lobe, measure both nodules. **Use dual imaging and number the nodules so that the nodules can be properly followed. Label the location of the nodules.**

**Torsion**
Must doppler both artery and Vein!!
**Abdominal Sonography**

**Liver:**
Sagittal and transverse views of the right and left lobes of the liver. Transverse views of the liver should include a transverse picture with the hepatic veins and IVC and a transverse picture with the portal vein. When ruling out biliary obstruction color right and left lobe proven no dilatation.

**CBD:**
Longitudinal view of the CBD with and without measurements

**Gallbladder:**
Sagittal and transverse views

**Spleen:**
Sagittal and transverse views

**Pancreas:**
Longitudinal views of the pancreatic head, body and tail

**Kidneys:**
Sagittal and transverse views.

**Aorta/IVC:**
Sagittal of abdominal aorta from liver to bifurcation. Sagittal of proximal abdominal aorta can be included in sagittal image of the left lobe of the liver. Sagittal view of the proximal IVC which may be included in the sagittal view of the right lobe of the liver.

### Guideline to a sequence of scanning

1. oblique view of pancreatic head, body, and tail (x4-5)
2. trans LT lobe liver
3. trans RT lobe liver including IVC and hepatic veins
4. trans RT lobe of the liver including portal veins (x1)
5. trans dome of right lobe of liver (x2)
6. sag LT lobe liver with prox abdominal aorta
7. sag mid abdominal aorta (label aorta)
8. sag distal abdominal aorta (label IVC)
9. sag RT lobe of liver with IVC
10. sag RT lobe of liver (x2)
11. sag RT kidney showing liver/kidney interface(x1)
12. sag RT kidney with color doppler
13. sag RT kidney (3) label lateral, mid and medial (measure length and AP dimensions)
14. trans RT kidney (x3) label upper, mid and low (measure width dimensions)
15. sag gb (x3), one of which is a decubitus view
16. trans gb (x3), one of which is a decubitus view
17. trans. gb wall measurement
18. longitudinal view CBD with and without measurements and color doppler (x3)
19. sag spleen (x2) 1 with length measurement
20. trans spleen (x2) 1with a width and length measurement
21. sag spleen/kidney interface
22. sag LT kidney with color doppler
23. sag LT kidney (x3) label lateral, mid and medial (measure length and AP dimensions)
24. trans LT kidney (x3) label upper, mid and low (measure width dimensions)

**Notes:**
- show all abnormalities in sag and trans. Measure abnormalities in three dimensions- (length and AP direction on sagittal view and width on transverse view)
  - Aneurysm- measure the AP and width on transverse view.
- Show level of renal arteries, if possible.
- if multiple lesions, then number and measure an appropriate number of lesions that can be followed on subsequent studies
- label specific location of the abnormality if not obvious on the static image (ie upper pole, right lobe)
**Right Upper Quadrant sonography**

**Liver:**
Sagittal and transverse views of the right and left lobes of the liver. Transverse views of the liver should include a transverse picture with the hepatic veins and IVC and a transverse picture with the portal vein.

**CBD:**
Longitudinal view of the CBD with and without measurements

**Gallbladder:**
Sagittal and transverse views

**Pancreas:**
Longitudinal views of the pancreatic head, body and tail

**Right kidney:**
Sagittal and transverse views.

<table>
<thead>
<tr>
<th>Guideline to a sequence of scanning</th>
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<tbody>
<tr>
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<td>6. sag LT lobe liver with prox abdominal aorta (label Aorta)</td>
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<td>13. sag gb (x3), one of which is a decubitus view</td>
</tr>
<tr>
<td>14. trans gb (x3), one of which is a decubitus view</td>
</tr>
<tr>
<td>15. trans gb wall measurement</td>
</tr>
<tr>
<td>16. longitudinal view CBD with and without measurements and color Doppler (x3)</td>
</tr>
</tbody>
</table>

**Notes:**
- show all abnormalities in sag and trans. Measure abnormalities in three dimensions- (length and AP direction on sagittal view and width on transverse view)
- if multiple lesions, then number and measure an appropriate number of lesions that can be followed on subsequent studies
- label specific location of the abnormality if not obvious on the static image (ie upper pole, right lobe)
Liver (only) sonography

Liver:
Sagittal and transverse views of the right and left lobes of the liver. Transverse views of the liver should include a transverse picture with the hepatic veins and IVC and a transverse picture with the portal vein.

Guideline to a sequence of scanning
1. trans lt lobe liver
2. trans rt lobe liver including IVC and hepatic veins
3. trans rt lobe of the liver including portal veins (x1)
4. trans dome of right lobe of liver (x2)
5. sag lt lobe liver with prox abdominal aorta (label Aorta)
6. sag rt lobe of liver with IVC (label IVC)
7. sag rt lobe of liver (x2)
8. sag liver/right kidney interface
9. sag gb (x3), one of which is a decubitus view
10. trans gb (x3) one of which is a decubitus view
11. trans gb wall measurement
12. CBD with and without measurements and color Doppler (x3)

Notes:
- show all abnormalities in sag and trans. Measure abnormalities in three dimensions- (length and AP direction on sagittal view and width on transverse view)
- if multiple lesions, then number and measure an appropriate number of lesions that can be followed on subsequent studies
- label specific location of the abnormality if not obvious on the static image (ie upper pole, right lobe)
Spleen (only) sonography

Spleen:
Sagittal and transverse views

<table>
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<tr>
<td>1. Sagittal view of spleen (x2), 1 length measurement</td>
</tr>
<tr>
<td>2. Sagittal view of spleen/kidney interface</td>
</tr>
<tr>
<td>3. Transverse view of spleen (x2) 1 with a width and length measurement</td>
</tr>
<tr>
<td>4. Color doppler at the hilum</td>
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</tbody>
</table>
Emergent Pelvic Ultrasounds ordered on Pregnant patients:
Follow Pelvic Ultrasound Protocol and include a Fetal Heart Beat image

Female Pelvis sonography

Both transabdominal and transvaginal exams should be performed unless there is a clinical reason not to perform the transvaginal exam

For endovaginal only exams- Follow the same Guideline for sequence of scanning as below

Uterus:
Sagittal views (right, left, and midline including cervix). Measure length and AP of uterus. Measure endometrial stripe
Transverse views (above uterus, fundus, body, cervix). Measure width.

Ovaries:
Sagittal and transverse views of both ovaries. Measure ovaries in three dimensions. (length and AP on sagittal view, width on transverse view)

Guideline to a sequence of scanning (for both transvesical and transvaginal exams)
1. Sag midline uterus. Measure length and AP dimension. Measure endometrial stripe
2. Trans uterus (largest view). Measure width.
3. Sag uterus, right
4. Sag RT ovary, with and without measurement – length and AP dimension
5. Color image and pulse doppler of artery and pulse doppler of vein
6. Trans RT ovary, with and without measurement – width dimension
7. Sag uterus, left
8. Sag LT ovary, with and without measurement – length and AP dimension
9. Trans LT ovary, with and without measurement – width dimension
10. Color image and pulse doppler of artery and pulse doppler of vein
11. Trans vagina
12. Trans cervix
13. Trans body
14. Trans fundus
15. Trans superior to uterus

Notes:
- measure endometrial stripe in sagittal view, not transverse view. In postmenopausal women, hormonal history important. In premenopausal women, LMP history important
- show abnormalities in sagittal and transverse views, measure in three dimensions (length and AP on sagittal view and width on transverse view

Follicular study (Wallingford’s office)
Follicular measurement. Measurement of follicles greater than 5mm (three dimensions).

Although ovarian torsion is generally a clinical diagnosis, ultrasound findings that can be helpful in the diagnosis include:
transvaginal scanning- look for edematous ovary with peripheral follicles, an associated ovarian mass, ovary in abnormal location, and marked tenderness when scanning directly over the ovary. However, the ovary has a dual blood supply and the presence of flow does not exclude an ovarian torsion. It is necessary to take color and duplex doppler bilaterally of both the artery and the vein.

FOR endovaginal scans following a transvesical scan- Remeasure the endometrial stripe and ovaries. If evaluation of the bladder is also requested, please evaluate bladder as outlined in the “Bladder (only) sonography” protocol.
Male pelvis sonography

Prostate:
Sagittal and transverse views. Measure gland in three dimensions (AP and length on sagittal view and width on transverse view)

Bladder:
Sagittal and transverse views. Measure prevoid and postvoid volumes.

Guideline to a sequence of scanning
1. Distend bladder
2. Sagittal midline, include bladder and prostate
3. Sagittal right bladder
4. Sagittal midline, measure prostate (AP and Length)
5. Sagittal left bladder
6. Transverse prostate, measure prostate (width)
7. Transverse mid bladder
8. Transverse right bladder
9. Transverse left bladder
10. Measure prevoid volume
11. Postvoid bladder. Measure postvoid volume

Notes:
Document ureteral jets as clinically necessary. Ex. Hydroureter, Stones, Obstruction
Bladder (only) sonography

Bladder:
Sagittal and tranverse views. Measure prevoid and postvoid volumes.

Guideline to a sequence of scanning

1. Distend bladder
2. Sagittal midline bladder
3. Sagittal right bladder
4. Sagittal left bladder
5. Transverse mid bladder
6. Transverse right bladder
7. Transverse left bladder
8. Document ureteral jets (investigate for 5 minutes minimally)
9. Measure prevoid volume
10. Postvoid bladder. Measure postvoid volume
**Retroperitoneal Complete (kidneys and aorta) sonography**

**Kidneys:**
Sagittal views of the kidneys, three images. Measure longitudinal dimension. Transverse view of the kidneys (upper, mid, and lower poles) in this order and **label**.

**Aorta:**
Sagittal and transverse views of proximal, mid and distal segments and bifurcation

**Guideline to a sequence of scanning**

| 1. | 3 Sagittal left kidney- medial, mid, and lateral (measure length and AP dimension) **Include spleen/kidney interface** |
| 2. | Sag left kidney color doppler |
| 3. | 3 Transverse left kidney- upper, mid, lower (measure width dimension) |
| 4. | 3 Sagittal right kidney- medial, mid, and lateral (measure length and AP dimension) **Include liver/kidney interface** |
| 5. | Sag right kidney color doppler |
| 6. | 3 Transverse right kidney- upper, mid, lower (measure width dimension) |
| 7. | 4 Sagittal aorta - prox, mid, distal and bifurcation |
| 8. | 4 Transverse aorta - prox, mid, distal and bifurcation with AP measurements |
| 9. | Use color and doppler interrogation of the kidneys and aorta, as necessary |

**Notes:**

- **Aneurysm**- measure the AP and width on transverse view. Show level of renal arteries, if possible.

- an abnormality should be shown in sag and trans, (ie: renal stone, cyst, angiomyolipoma, solid mass). Measure in longest dimension if 1 cm or less. If greater than 1 cm, measure in three dimensions. (AP and length on sagittal view, width on transverse view)

- show the liver/kidney interface for echogenicity comparison.

- **If hydronephrosis is present, look at bladder. If the bladder is full, empty bladder and reimage the kidneys**
Retroperitoneal Complete (kidneys and bladder) sonography

Kidneys:
Sagittal views of the kidneys, three images. Measure longitudinal dimension. Transverse view of the kidneys (upper, mid, and lower poles) in this order and label.

Bladder:
Sagittal and tranverse views with the bladder distended. Measure prevoid volume. Have patient void and then measure postvoid volumes.

Guideline to a sequence of scanning

| 1. Distend bladder          |
| 2. Sagittal midline of bladder |
| 3. Sagittal right of bladder |
| 4. Sagittal left of bladder |
| 5. Transverse mid of bladder |
| 6. Transverse right of bladder |
| 7. Transverse left of bladder |
| 8. Document ureteral jets (investigate for 5 minutes minimally) |
| 9. Measure prevoid volume |
| 10. Postvoid bladder. Measure postvoid volume |
| 11. 3 Sagittal left kidney- medial, mid, and lateral (measure length and AP dimension) Include spleen/kidney interface |
| 12. Sag left kidney color doppler |
| 13. 3 Transverse left kidney- upper, mid, lower (measure width dimension) |
| 14. 3 Sagittal right kidney- medial, mid, and lateral (measure length and AP dimension) Include liver/kidney interface |
| 15. Sag right kidney color doppler |
| 16. 3 Transverse right kidney- upper, mid, lower (measure width dimension) |

Notes:
- an abnormality should be shown in sag and trans, (ie: renal stone, cyst, angiomyolipoma, solid mass).
- show the liver/kidney interface for echogenicity comparison.
- Document ureteral jets, as clinically necessary
Aortic (only) Retroperitoneal Limited sonography

Aorta:
Sagittal and transverse views of proximal, mid and distal segments and bifurcation

Guideline to a sequence of scanning

1. Sagittal proximal aorta
2. Sagittal mid aorta
3. Sagittal distal aorta
4. Transverse prox aorta with AP measurement
5. Transverse mid aorta with AP measurement
6. Transverse distal aorta with AP measurement
7. Transverse at bifurcation
8. Use color and doppler interrogation of the aorta, as necessary

Notes:
*Aneurysm- measure the AP and width on transverse view.* Show level of renal arteries, if possible.
**Renal (only) Retroperitoneal Limited sonography**

**Kidneys:**
Sagittal views of the kidneys, three images. Measure longitudinal dimension. Transverse view of the kidneys (upper, mid, and lower poles) in this order and label.

**Guideline to a sequence of scanning**

| 1. | 3 Sagittal left kidney- medial, mid, and lateral (measure length and AP dimension) Include spleen/kidney interface |
| 2. | Sag left kidney color doppler |
| 3. | 3 Transverse left kidney- upper, mid, lower (measure width dimension) |
| 4. | 3 Sagittal right kidney- medial, mid, and lateral (measure length and AP dimension) Include liver/kidney interface |
| 5. | Sag right kidney color doppler |
| 6. | 3 Transverse right kidney- upper, mid, lower (measure width dimension) |
| 7. | Use color and doppler interrogation of the kidneys, as necessary |

**Notes:**
- an abnormality should be shown in sag and transverse, (ie: renal stone, cyst, angiomyolipoma, solid mass).
- show the liver/kidney interface for echogenicity comparison.
- If hydronephrosis is present, look at bladder. If the bladder is full, empty bladder and reimage the kidneys
**Penis Ultrasound:**

**Equipment:** Penile studies should be conducted with a real-time scanner, preferably using frequencies greater than 10 MHz with a linear array transducer. The highest possible Doppler frequencies (typically greater than 10 MHz) providing optimal resolution and flow detection should be used.

**Approach:** Either ventral and/or dorsal depending on which provides the best visualization or the corporal bodies and urethra.

**Penis Imaging Protocol:**

1. 3 Transverse images- Proximal, mid, distal phallus
2. Multiple Long images: Both the right and left corpora cavernosa, including the cavernosal artery.
3. Doppler and spectral analysis of the vessels that can be visualized (cavernosal arteries, dorsal arteries, deep dorsal vein)
Appendix sonography

Appendix/RLQ:
Sagittal and transverse views of the right lower quadrant and the area where the patient has pain. Label orientation and location. Perform with linear and curvilinear probes. Compression ultrasound with a linear probe.

Guidelines to a sequence of scanning

1. Transverse images of the right lower quadrant and at the area of the patient’s pain
2. Sagittal images of the right lower quadrant and at the area of the patient’s pain
3. Compression of the right lower quadrant and at the area of the patient’s pain (utilize split screen labeling image w/ and w/out compression.
4. Color, power and duplex doppler interrogation as needed.

Notes:
Ask patient to point to the area of pain with one finger. This can help in finding the appendix. Make sure to examine this area even it is not in the right lower quadrant. Make sure to also examine the right lower quadrant.

Perform compression ultrasound with -resolution (≥ 7.5 MHz) linear array transducer at the right lower quadrant and at the area of the patient’s pain. When performing the graded compression, the common femoral artery and vein is identified in order to orient to the RLQ. The patient is then scanned cephalad from this position. The transducer is then used to compress the RLQ, including the terminal ileum and the cecum, to identify any possible appendix. Better compression is obtained if the left hand is placed behind the patient’s flank.

An abnormal appendix appears as a dilated (> 6mm), tubular, non-compressible, non-peristaltic, blind-ending structure originating from the cecum. The signs for appendicitis include:
   - Thickened wall > 3mm
   - Diameter > than 6mm
   - Blind-ending tubular structure
   - Non-compressible
   - Appendicolith
   - Circumferential color flow
   - Free fluid
   - Abscess

The lack of visualization of an abnormal appendix does NOT exclude appendicitis.

Normal bowel can mimic an abnormal appendix. Normal bowel peristalses with time and should be compressible.

Females: Complete female pelvic sonography
Perform pelvic sonography in females as per female pelvic sonography protocol and include RLQ.
Charge pelvic ultrasound

Males: RLQ sonography
Perform RLQ protocol as per the Appendix sonography above.
Charge abdomen limited
**First Trimester Pregnancy Ultrasound**

**Uterus:**
Sagittal uterus, transverse of fundus, cervix and vagina.

**Ovaries:**
Sagittal and/or transverse view of both ovaries. Measure ovaries.

**Gestational sac:**
Show gestational sac and its location in the uterus. Show yolk sac, fetal pole and amnion. Measure crown-rump-length (CRL) or measure gestation sac in three dimensions if CRL is out of range. Do M-mode for heart rate.

**Fetal Heartbeat:** IF fetal pole measures <7weeks and no FHB is seen DO NOT report a fetal demise. Should state a follow up scan is needed. If the fetal pole measures >7weeks and no fetal heartbeat is seen it can be reported out as a fetal demise.

<table>
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<tr>
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<tbody>
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</tr>
<tr>
<td>2. Trans uterus (largest view). Measure width.</td>
</tr>
<tr>
<td>3. Sag uterus, right</td>
</tr>
<tr>
<td>4. Sag rt ovary, with and without measurement – length and AP dimension</td>
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<tr>
<td>5. Trans rt ovary, with and without measurement – width dimension</td>
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<tr>
<td>6. Sag uterus, left</td>
</tr>
<tr>
<td>7. Sag lt ovary, with and without measurement – length and AP dimension</td>
</tr>
<tr>
<td>8. Trans lt ovary, with and without measurement – width dimension</td>
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<tr>
<td>9. Trans vagina</td>
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<tr>
<td>10. Trans cervix</td>
</tr>
<tr>
<td>11. Trans body</td>
</tr>
<tr>
<td>12. Trans fundus</td>
</tr>
<tr>
<td>13. Trans superior to uterus</td>
</tr>
<tr>
<td>14. Sagital fundus, include the gestational sac</td>
</tr>
<tr>
<td>15. Transverse fundus, include the gestational sac</td>
</tr>
<tr>
<td><strong>NO COLOR DOPPLER/ DOPPLER ON A VIABLE IUP</strong></td>
</tr>
<tr>
<td>16. Measure crown rump length (x2)</td>
</tr>
<tr>
<td>17. Measure gestational sac if CRL is out of range</td>
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<tr>
<td>18. Show yolk sac, fetal pole, amnion</td>
</tr>
<tr>
<td>19. Do M-mode for heart rate</td>
</tr>
</tbody>
</table>

**Notes:**
- If no heart movement is seen on transabdominal scan, then an endovaginal scan must be done.
- Be sure to scan through the entire ovary superiorly/inferiorly and right-to-left.

*Use the same guidelines for endovaginal only exams*
Obstetrical Ultrasound – 2nd and 3rd trimester

Placenta:
Sagittal and transverse views. Show placenta’s relationship to cervical os.

Amniotic fluid volume:
Show sagittal and transverse view of largest fluid pocket. Depth measurement of largest pocket. Label AFV

Fetus:

Guideline to a sequence of scanning
1. Sagittal midline of cervix to show internal os and placenta relationship.
2. Sagittal view to demonstrate fetal lie.
3. Three images of placenta (sagittal of lower edge, sagittal of upper edge, transverse).
4. Sagittal and transverse views of largest pocket of amniotic fluid volume. Label “AFV”
5. Depth measurement of largest pocket of amniotic fluid
6. Two BPD measurements and two HC measurements at level of thalami and cavum septum.
7. Image the cavum septum, cerebellum/posterior fossa, choroids/lateral ventricles.
8. Coronal view of the nose, lips and mouth
9. Sagittal profile of nose, lips and chin
10. Axial view of neck at correct angle, color doppler if abnormal
11. Three sagittal spine images of the cervical, thoracic, lumbosacral spines.
12. Three representative transverse images of the cervical, thoracic, lumbosacral spines. It is important is to perform a meticulous dynamic scan of the spine transversely from cervical spine to sacrum to identify any posterior defects in the spine.
13. Image diaphragm
15. M-mode of heart and measure heart rate
16. Coronal or sagittal of abdomen and chest to show the stomach and heart on the same side
17. Transverse image of both kidneys.
18. Sagittal images of both kidneys.
20. Image of the stomach
21. Two AC measurement, at level of umbilical vein.
22. Two FL measurements.
23. Transverse image of a three vessel cord. **RES this image**
24. Transverse color doppler image through fetal bladder showing 2 umbilical arteries
25. Doppler of three vessel cord and measure SD ratio.
26. Cord insertion to fetus and ventral wall of the fetus
27. Four major extremities
28. Label stomach, kidneys, bladder, heart, posterior fossa, cervical spine, thoracic spine, lumbosacral spine, 3 vessel cord and cord insertion
29. Report page (1st and 2nd pages)
30. Print growth chart

Notes:
If the internal os of the cervix and/or the inferior aspect of the placenta and their relationship to one another is not well seen, consider a translabial scan.

Always scan the spine transversely from cervical spine to sacrum to exclude any spinal dysraphism
**Emergent Limited Obstetrical Ultrasound**

Indication: Emergent Ultrasound. *Charge Limited OB*

**Guideline to a sequence of scanning**

1. Sagittal midline of cervix to show internal os and placenta relationship.
2. Sagittal view to demonstrate fetal lie.
3. Three images of placenta (sagittal of lower edge, sagittal of upper edge, transverse).
4. Sagittal and transverse views of largest pocket of amniotic fluid volume. Label “AFV”
5. Depth measurement of largest pocket of amniotic fluid
6. M-mode of heart and measure heart rate
7. 1 BPD
8. 1 Head Circumference
9. 1 Abdominal Circumference
10. 1 Femur measurement

**Fetal Heartbeat (only) sonography**

Indication: Used only to document fetal viability during a pelvic ultrasound.

**Guideline to a sequence of scanning**

1. Image of Fetal Heart
2. M-mode of heart and measure heart rate
Carotids:
Sagittal and transverse grey scale. Duplex doppler interrogation of CCA, ECA, ICA. Color doppler to look for areas of stenosis (narrowing by hypoechoic plaque, turbulence)

**A Grey scale transverse image of the vessel is required to demonstrate area of excessive plaque.**

**Start exam on left side**

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<th>Guideline to a sequence of scanning</th>
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<tr>
<td>Both sides</td>
</tr>
<tr>
<td>1. Trans Prox CCA (1)</td>
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<tr>
<td>2. Trans Mid CCA (1)</td>
</tr>
<tr>
<td>3. Trans Dist CCA (1)</td>
</tr>
<tr>
<td>4. Trans Bulb (1)</td>
</tr>
<tr>
<td>5. Trans Bifurcation (1)</td>
</tr>
<tr>
<td>6. Sagital Prox/Mid CCA Gray scale, Color and Doppler (3)</td>
</tr>
<tr>
<td>7. Sagital Distal CCA Gray scale, Color and Doppler (3)</td>
</tr>
<tr>
<td>8. Sagital Bulb Gray scale, Color and Doppler (3)</td>
</tr>
<tr>
<td>9. Sag ICA Gray Scale and Color (2)</td>
</tr>
<tr>
<td>10. Sag Prox ICA Color and Doppler (2)</td>
</tr>
<tr>
<td>11. Sag Mid ICA Color and Doppler (2)</td>
</tr>
<tr>
<td>12. Sag Dist ICA Color and Doppler (2)</td>
</tr>
<tr>
<td>13. Sag ECA Gray scale, Color and Doppler (3)</td>
</tr>
<tr>
<td>14. Sag Vertebral Color and Doppler (2)</td>
</tr>
<tr>
<td>Repeat for Right Side...............</td>
</tr>
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</table>

**Use color Doppler to examine CCA, BULB, ICA, ECA for identifying turbulence or narrowing of lumen by hypoechoic plaque. If the narrowing by hypoechoic plaque is not visible on grey-scale images, provide color Doppler images, sagittal and transverse, of this area. If an area of turbulence or narrowing is noted, then also Duplex doppler that particular area.

Notes:
Duplex doppler: align the angle to be as parallel as possible to the vessel. The angle should be as small as possible while still remaining parallel to the vessel and not to exceed 60 degrees.
**Thyroid Sonography**

**Thyroid:**
Sagittal and transverse scanning of thyroid gland. Measure in three dimensions.

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<tr>
<td>1. Sagittal Left carotid</td>
</tr>
<tr>
<td>2. Three sagittal Left thyroid images, lateral, mid, medial, measure the gland (AP and length). LABEL</td>
</tr>
<tr>
<td>3. Three transverse Left thyroid images, upper, mid, lower pole, measure width at middle of gland. LABEL</td>
</tr>
<tr>
<td>4. Repeat for the Right side</td>
</tr>
<tr>
<td>5. Transverse midline showing isthmus and both sides together. Measure isthmus</td>
</tr>
<tr>
<td>6. Transverse midline demonstrating bilateral glands with color doppler</td>
</tr>
</tbody>
</table>

Notes:
- Perform the exam before measuring the nodules. Measure the nodules at the end of the exam. Measure the largest nodules or **most suspicious nodules** on each side (no more than three nodules). Measure in three dimensions (AP and length on sagittal view, width on transverse view. If there are two dominant nodules in a lobe, measure both nodules. Use dual imaging and number the nodules so that the nodules can be properly followed. Label the location of the nodules.

**Suspicious features**
- Entirely solid
- Hypoechoic
- Microcalcifications
- Associated Cervical LNA

**Re-assuring features**
- Cystic elements
- Hyper or isoechoic
- Eggshell calcifications
- Invissated
Thyroidectomy Protocol

Post op thyroidectomy
Evaluate thyroidectomy site for residual or new thyroid tissue.

Guideline to a sequence of scanning
1. Sagittal Bilateral thyroid bed
2. Transverse Bilateral thyroid bed
3. Bilateral neck imaging looking for **abnormal lymph nodes .....Measure abnormal lymph nodes only

**Abnormal lymph nodes
Cystic changes
Asymmetric cortical thickening
>5mm in short access
Calcification
Testicular Sonography

Testis:
Sagittal and transverse views. Color and duplex doppler interrogation. (i.e. epididymitis / orchitis, torsion).
Measure testis (three dimensions)

Epididymis:
Sagittal view, measure epididymal head.

Start exam on Left side

Guideline to a sequence of scanning
1. Four sagittal images of the left testicle, label lateral, mid, medial and measure the length and AP
2. Two sagittal left epididymis, 1 with craniocaudal measurement
3. Collor doppler of epididymis
4. Four transverse images left testicle, label upper, mid, lower and measure width at mid testicle.
5. Pulse Doppler of the testis (Include artery and Vein)
6. Repeat for the right side
7. Transverse side-by-side color Doppler of both testis to compare testicular flow.
8. Transverse image of both testicles in one image to compare echogenicity.

Notes:
- Varicocele-do grey scale, pre and post valsalva maneuver images to show vessel size.

- Torsion- do color image showing transverse of both testicles in one image with same color settings to show comparison of color. Doppler both vein and artery of each testicle for further proof of blood flow to the testicles.
**Lower extremity DVT**

Start on Left extremity

**Guideline to a sequence of scanning**

1. Sagittal CFV and GSV with color and doppler
2. Sagittal CFV with doppler and Valsalva************ If flattened or pulsatile flow is present repeat on opposite leg.

*Transverse images starting at CFV to FV to popliteal trifurcation with and without compression, Split screen with the left side labeled without compression and the right side with compression. Label center of the screen “cfv-pop”and respective side.*

3. Transverse CFV (Proximal to GSV Junction)
4. Transverse CFV (at GSV junction)
5. Proximal Femoral Vein including profunda Vein
6. Mid Femoral Vein
7. Distal Femoral Vein
8. Popliteal Vein
9. Trifurcation
10. Posterior Tibial Veins with and w/out compression and a Sagital image with color.
11. Peroneal Veins with and w/out compression and a Sagital image with color.

**Also label and scan any area of pain.**

**Notes:**

*If positive for DVT, label picture with location to help define the extent of the thrombus.*

Use augmentation and respiratory variation as necessary. (ie. Augmentation to determine if there is recanalization or collateral flow. Respiratory variation at the CFV ~ if there is dampened or absent respiratory variation this may suggest proximal thrombus or obstruction.)

Identify and examine for duplicated systems. Label film if you image a duplicated system.

Use color Doppler to help identify veins and presence of flow.

*Evaluate area of pain (ie calf) to see if there is a superficial or deep calf thrombosis in the area of pain and/or swelling.*
Upper extremity DVT

Start on Left extremity

Jugular vein, subclavian vein and prox axillary veins: 2D, Color and Duplex doppler images

Axillary-brachial veins: Split screen to do compression pictures.

<table>
<thead>
<tr>
<th>Guideline to a sequence of scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sagittal IJV. (2D, Doppler, and Color)</td>
</tr>
<tr>
<td>2. Transverse Images of IJV (x2) include prox and distal with and w/out compression</td>
</tr>
<tr>
<td>3. Sagittal subclavian vein. (2D, Doppler, and Color)</td>
</tr>
<tr>
<td>4. Sagittal axillary vein. (2D, Doppler, and Color)</td>
</tr>
<tr>
<td>5. Transverse axillary vein w/ and w/o compression</td>
</tr>
<tr>
<td>6. Transverse brachial vein w/ and w/o compression. Proximal, mid, and distal.</td>
</tr>
<tr>
<td>7. Sagittal brachial - Color/ Doppler</td>
</tr>
<tr>
<td>8. Transverse basilic vein w/ and w/o compression</td>
</tr>
<tr>
<td>10. Transverse Cephalic Vein w/ and w/out compression. Proximal, mid and distal</td>
</tr>
<tr>
<td>11. Sagittal Cephalic Vein Color and Doppler</td>
</tr>
</tbody>
</table>

Notes:
- if positive for DVT you must LABEL the vessel’s specific location of the DVT
**Infant Cranial Sonogram**

Indications: prematurity, hemorrhage, IUGR

Scanning planes:

**Coronal** (through anterior fontanel) - scan from posterior orbital ridge through occipital lobe.
Images should demonstrate the following:
- Orbital ridge, cavum septum pellucidum, frontal horns of lateral ventricles, thalamus, germinal matrix, lateral ventricles, choroid plexus, cerebellum, and occipital lobe.
Approx: 10-12 images

**Sagittal**
Midline sagittal image demonstrates the cavum septum pellucidum, corpus callosum, 3rd ventricle, 4th ventricle and cerebellum
Scan to the right to demonstrate the lateral ventricle, germinal matrix, thalamus, choroids plexus.
Scan thru to the sylvian fissure
Repeat for left side.

**Guidelines to a sequence of scanning**
1. 8 Coronal images anterior to posterior
2. 1 Sagittal mid line
3. 6 Sagittal images sweeping through to left
4. 1 sagittal mid line
5. 6 sagittal images sweeping through to right
Mesenteric Artery Stenosis Sonogram

PATIENT MUST BE FASTING FOR THIS EXAM

Indications: Mesenteric stenosis, mesenteric ischemia

The study must be performed in a fasting patient

Obtain peak systolic and end diastolic velocities in the longitudinal plane in the following arteries
- Celiac artery trunk
- Proximal, mid and distal superior mesenteric artery
- Inferior mesenteric artery, if possible
- Aorta

<table>
<thead>
<tr>
<th>Guideline to a sequence of scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Grey scale of Aorta</td>
</tr>
<tr>
<td>2. Pulse doppler of Aorta</td>
</tr>
<tr>
<td>3. Grey scale and Pulse doppler of celiac artery trunk</td>
</tr>
<tr>
<td>4. Grey scale and Pulse doppler of proximal, mid and distal superior mesenteric artery</td>
</tr>
<tr>
<td>5. Grey scale and Pulse doppler of inferior mesenteric artery, if possible</td>
</tr>
</tbody>
</table>

Interpretation

An abnormal fasting peak systolic velocity in the celiac artery of > 200 cm/sec is predictive of a 70-99% diameter reduction.

An abnormal fasting peak systolic velocity in the superior mesenteric artery or > 275 cm/sec is predictive of a 70-99% diameter reduction.

However, an arteriogram is essential in confirming the diagnosis.

The waveforms should have a characteristic profile with spectral broadening and post-stenotic turbulence.
Renal Artery Stenosis Sonogram

Indications: Renal artery stenosis

Kidney Morphology:
Evaluate both kidneys similar to a renal ultrasound obtain kidney size and assessing for masses, hydronephrosis, calculi, etc.

Renal Arteries:
Pulse Doppler evaluation of the renal arteries at its proximal (near origin from aorta), mid, and distal portion (at or near hilum). Record peak systolic and end diastolic velocities. Use power Doppler to help in identifying renal arteries, use color Doppler to assess for any areas of turbulence.

Pulse Doppler evaluation of the segmental arteries in the upper and lower poles. Record peak systolic and end diastolic velocities, acceleration time, and resistive indices and end diastolic ratio.

Pulse Doppler of the aorta just distal to the superior mesenteric artery. Record peak systolic and end diastolic velocities.

Look for any secondary or accessory renal arteries.

Guideline to a sequence of scanning

1. Sagittal left kidney- medial, mid, and lateral (measure length at mid)(Include spleen/kidney interface)
2. Transverse left kidney- upper, mid, lower
3. Repeat Steps 1 and 2 for the right side (Include liver/kidney interface)
4. Grey scale longitudinal Aorta
5. Pulse Doppler of Aorta just below SMA origin
6. Grey scale left renal artery
7. Pulse Doppler left renal artery (prox, mid, distal)
8. Pulse Doppler segmental arteries in upper and lower poles (RI and EDR)
9. Repeat steps 7-9 for the right side
10. Show any accessory renal arteries

Interpretation
Use the RAR and AT to determine the presence of a renal artery stenosis.

Renal-to-aortic ratio (RAR): Renal artery PSV/ Aortic PSV
Normal: < 3.5
Abnormal: > or = 3.5 (this indicates a 60% or greater diameter reduction)

Note: If the aortic peak systolic velocity is pathologically affected (ie aortic stenosis), then some consider a renal artery peak systolic velocity of 180 to 200 cm/sec or greater to be abnormal (> 60% diameter reduction)

The waveform within the renal artery should conform to a stenosis profile with spectral broadening and post-stenotic turbulence.

Kidney Arterial Flow: Evaluation of the segmental arteries
Acceleration time (AT): time interval from the onset of systole to the initial peak.
Abnormal: AT > 100 msec (proximal stenosis of > 60% diameter reduction)
End-diastolic ratio: End diastolic velocity/ peak systolic velocity
Normal > 0.2
Abnormal < 0.2 (indicates an increase in resistance within the kidney parenchyma)
Resistive index (RI): (PSV-EDV)/PSV
Normal: <0.7
Abnormal: >0.7 (indicates an increase in resistance within the kidney parenchyma)
**Renal Vein Doppler**
Indication: Renal vein thrombosis

**Guideline to a sequence of scanning**
1. 3 Sagittal left kidney- medial, mid, and lateral (measure length at mid) *(Include spleen/kidney interface)*
2. Sag left kidney color doppler
3. 3 Transverse left kidney- upper, mid, lower
4. Grey scale longitudinal IVC
5. Color and Pulse Doppler of IVC
6. Grey scale left renal vein. (Prox, Mid and distal)
7. Color and Pulse Doppler left renal vein (prox, mid, distal)
8. Doppler Renal vein at Hilum
9. Repeat Steps 1-8 for the right side
**Lower Extremity Pre CABG MAP**

**Start on Right extremity**

**Indications:** Pre op CABG

<table>
<thead>
<tr>
<th>Scanning Planes: Transverse images from GSV in groin moving to the most distal aspect of GSV. Utilize split screen and include with and without compression. Utilize calipers for documentation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 total images (per side)</td>
</tr>
<tr>
<td>3 images with transverse measurements above knee (label AK) w/ and w/o compression</td>
</tr>
<tr>
<td>3 images with transverse measurements below knee (label BK) w/ and w/o compression</td>
</tr>
</tbody>
</table>

Surgeons prefer the diameter of the vessels to be >2mm. You are to demonstrate as much of the GSV as you are able to see.

Please fill appropriate worksheet.
- Place copy in chart; In the Diagnostic Procedural Results Section (Light Blue Tab).
- Scan into Synapse.
- Fax worksheet to 1768. This is the Cardiology private office.

- Using indelible marker draw a Sagital mark on the distal thigh area marking the GSV. (for surgeon)

- Measure the depth of the GSV at the distal thigh (just above knee) and in the upper calf (just below the knee). These measurements need to be written on the worksheet in their respective location. See attached example.

****If a patient has a harvested vessel please include an image on the study and document on the worksheet.

**Important:** The Cardiology Group has requested a wet reading of any Carotid studies done at the time of the Pre CABG study. This is to be written at the bottom of the worksheet. See attached example.
**Pseudoaneurysm check**

Indication: Puncture to artery with swelling

<table>
<thead>
<tr>
<th>Guideline to a sequence of scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. sagittal image of CFA</td>
</tr>
<tr>
<td>2. Color/spectral doppler sagittal CFA (x2)</td>
</tr>
<tr>
<td>3. Color transverse CFA</td>
</tr>
<tr>
<td>4. transverse CFA</td>
</tr>
<tr>
<td>5. sagittal image of CFV</td>
</tr>
<tr>
<td>6. Color/spectral doppler sagittal CFV (x2)</td>
</tr>
<tr>
<td>7. transverse CFV</td>
</tr>
<tr>
<td>8. sagittal image of FA</td>
</tr>
<tr>
<td>9. Color/spectral doppler sagittal FA (x2)</td>
</tr>
<tr>
<td>10. transverse FA</td>
</tr>
<tr>
<td>11. sagittal image of FV</td>
</tr>
<tr>
<td>12. Color/spectral doppler sagittal FV (x2)</td>
</tr>
<tr>
<td>13. transverse FV</td>
</tr>
<tr>
<td>14. Sagittal image of puncture site. <strong>Label</strong></td>
</tr>
<tr>
<td>15. Color sagittal of puncture site. <strong>Label</strong></td>
</tr>
<tr>
<td>16. Transverse image of puncture site. <strong>Label</strong></td>
</tr>
<tr>
<td>17. Color transverse of puncture site. <strong>Label</strong></td>
</tr>
</tbody>
</table>
**Reminder : use inner to inner measurements!**

**AV Fistulas and Bypass Procedures using Upper extremities**

<table>
<thead>
<tr>
<th>Must do an <strong>insitu</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Document cephalic vein from upper arm to wrist (6 images) label <strong>3 above anticubital, 3 below antecubital</strong></td>
</tr>
<tr>
<td>2. Document basilic vein from upper arm to wrist (6 images) label <strong>3 above anticubital, 3 below antecubital</strong></td>
</tr>
</tbody>
</table>

**** mark location of veins with indelible markers****

Please fill appropriate worksheet out.
- Place copy in chart or fax copy to floor (call and notify nurse of pending fax)
- scan into Synpase
**INSITU Mappings (Revase.)**

Must do an *insitu*

1. *Do the affected side with Split screen including w/ and w/o compression on ALL images.*  
   *Utilize calipers for documentation.*

2. Map the GSV (label AK & BK) (if appropriate in length STOP) If not
3. Map the opposite GSV (label AK & BK) (if appropriate in length STOP) If not
4. Map bilateral LSV (if appropriate in length STOP) If not
5. Map the non dominant arm (Cephalic)

**** *mark location of veins with indelible markers****

**Make sure to document any dominant branches and any loop systems**

Please fill appropriate worksheet out.
- Place copy in chart or fax copy to floor (call and notify nurse of pending fax)
- scan into Synpase
1. Doppler native vessel just proximal to anastomosis. (expect turbulent flow)
2. Doppler 1-2 cm past anastomosis.
3. Doppler several areas throughout the graft.
4. Doppler 1-2 cm pre distal anastomosis.
5. Doppler at distal anastomosis site.
6. Doppler 1-2 cm distal to anastomosis in the native vessel.

>250 cm/sec would alert the surgeon of any problems
*Look for any fluid collections around graft and document areas
Abdomen Doppler (Portal Vein Study)

Guideline to a sequence of scanning

1. Transverse Left Lobe X 2
2. Transverse Right Love Liver X 3 (include Hepatic Veins with gray scale, color and doppler each vein)
3. Image ALL Hepatic Veins with gray scale, color and doppler.
4. Image Main Portal Vein with gray scale, color and doppler.
5. Image Right and Left branches of Portal Vein with gray scal, color and doppler.
6. Image Hepatic Artery gray scale, color and doppler.
7. Left Hepatic artery gray scale, color and doppler
8. Right Hepatic artery gray scale, color and doppler
9. Sag Left lobe
10. Sag IVC gray scale, color and doppler.
11. Sag Right Lobe Liver X 3
12. Spleen Sag and Trans include color at hilum and doppler Splenic Vein.
13. Check for Ascites

Notes:
Pseudoaneurysm Thrombin Injection Protocol

Guideline to a sequence of scanning

Protocol for In-patients

1. Inform PA and discuss the possibility of Thrombin Injection and a time.
2. Inform Angio RN after time is established
3. Call Patient’s RN with results and to inform the RN that there needs to be an order in the chart or script requesting the Thrombin Injection.
4. Angio will arrange for consent to be signed by the patient when he/she arrives in the department.

Notes: ALL pseudo thrombin injection patients will need to be re-scanned within 24 hours.

Guideline to a sequence of scanning

Protocol for Out-patients

1. Inform PA and discuss the possibility of Thrombin Injection and a time.
2. Inform Angio RN after time is established
3. Call Patient’s MD with results and to inform the MD that there needs to be a script requesting the Thrombin Injection.
4. Angio will arrange for consent to be signed by the patient when he/she arrives in the department.

Notes: ALL pseudo thrombin injection patients will need to be re-scanned within 24 hours.
Radial Artery for CABG MAP

Start on Left extremity unless otherwise indicated

Indications: Pre op CABG

Scanning Planes: Transverse and Sagital images from Prox Radial Artery to Distal Radial Artery.
9 total images (per side)
3 transverse images with measurements at Prox, Mid and Distal
3 Color Sagital images at Prox, Mid and Distal
3 Spectral Dopplers at Prox, Mid and Distal
VELOCITIES:

1. Portal Vein: ________ cm/sec
2. Proximal Stent: ________ cm/sec
3. Distal Stent: ________ cm/sec
4. Hepatic Vein / IVC: ________ cm/sec

Areas Of Acceleration: ____________________________________________________________

Comments: _________________________________________________________________________________________________

______________________________

______________________________

______________________________

Direction Of Flow: (Check One)
(    ) Portal to Hepatic
(    ) Hepatic to Portal
(    ) No Flow

**TIPS velocity below 50 cm/s evaluate for ascites, splenomegaly and portal venous changes.**
**Renal Transplant**

*survey for collections*

1. Renal protocol  
   *Pulse Wave Doppler and Spectral Analysis with RIs and PSV of:*
2. Iliac Artery and Vein
3. Anastomosis
4. Main Renal Artery and Vein
5. Interlobar and Arcuate Arterial segments (Lower, Mid and Upper) **Use proper angle**

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**Pancreas Transplant**

1. Measure Pancreas Sag and trans
2. Pulse Wave Doppler measurements of Iliac Artery and Iliac Vein
3. Pulse Wave Doppler Intrapancreatic Artery and Intrapancreatic Vein

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**Liver Transplant**

4. Liver Ultrasound protocol
5. Main Portal Vein Color Doppler and Pulsed Wave Doppler (include Peak Velocity)
6. Right Portal Vein Color and Doppler
7. Left Portal Vein Color Doppler and Pulsed Wave Doppler
8. Hepatic Artery Pulsed Wave Doppler of Main, Right and Left (Measure RI)
9. Hepatic Veins Pulse Wave Doppler of all 3 veins
10. Images of IVC