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# SRS US PROTOCOLS

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**ORDER DISAMBIGUATION:**

For exam ordering purposes, the liver and gallbladder are separate organs. The intra- and extrahepatic ducts are included with the gallbladder. The possible exams done at one visit include **ONE** of the following: single organ exam, a single quadrant (RUQ, LUQ, etc) exam, or an abdominal exam. If two or more single organ studies are ordered in the same quadrant, the order must be changed to an exam of that quadrant. If one or more organ is ordered in more than one quadrant, the order must be changed to an abdominal exam. Thus, if a liver ultrasound and a gallbladder ultrasound are order, the order should be changed to a RUQ ultrasound. If a liver ultrasound and bilateral kidney ultrasound are ordered, the exam should be changed to an abdominal ultrasound.

**GALLBLADDER**

**DATE OF EDIT:**

October 25 2023

**INDICATION:**

Perform this study whenever a gallbladder ultrasound is ordered. If the patient has had a cholecystectomy, the order must be changed to liver ultrasound, right upper quadrant ultrasound, or abdominal ultrasound.

**PREP:**

Prep – NPO for 6 to 8 hours before examination (clear liquids and medications allowed if patient is diabetic). Infants should be NPO for three hours.

**HISTORY NOTE:**

Note the type of pain, location, duration, and association with certain types of foods. Note abnormal lab values if available.

**REVIEW:**

The technologist should review pertinent previous ultrasound, computed tomography, and nuclear medicine images and/or reports. Pay particular attention to previous exams which prompted the current study.

**IMAGING:**

**GALLBLADDER ONLY**

- longitudinal
- transverse
- Supine, decubitus, erect positions
- CHD proximally and at head of pancreas
- Liver to document no intrahepatic dilatation
- Do not particularly look at or image other organs such as the kidney, or pancreas unless an abnormality is seen incidentally. If an abnormality is seen incidentally, document with images and note.

## IMAGING NOTE:

Note whether or not stones are present, and if so the general number (one, two, three, several, numerous, etc.). Note duct diameter. Very important – specifically note whether or not there is a positive ultrasonographic Murphey’s sign. WNL is acceptable if appropriate.

- Note gallbladder wall thickness if wall is irregular
- Note presence of polyp
- Note presence of pericholecystic fluid

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## RIGHT UPPER QUADRANT (RUQ)

### DATE OF EDIT:

June 7, 2016

### INDICATION:

See order disambiguation above

### PREP:

Prep – NPO for 6 to 8 hours before examination (clear liquids and medications allowed if patient is diabetic). Infants should be NPO for two hours.

### REVIEW:

The technologist should review pertinent previous ultrasound, computed tomography, and nuclear medicine images and/or reports. Pay particular attention to previous exams which prompted the current study. For example, the technologist should pick up the fact that the ultrasound of the kidneys was recommended by the radiologist who was interpreting a CT of the abdomen. The technologist should review the CT exam and, after performing the ultrasound, should note the findings about the particular lesion in question.

### HISTORY NOTE:

Note the type of pain, location, duration, and association with certain foods. Note abnormal lab values if available. Note palpable abnormalities. Search for metastatic disease or neoplasm.

### IMAGING:

Begin with patient supine and scan epigastrium

### LONGITUDINAL SCANS:

- Midline view of aorta and left lobe of liver.
- Image IVC and caudate lobe – caudate lobe size
- Multiple scans of right lobe with vasculature (hepatic and portal veins, demonstrate the direction of flow with Doppler of the portal vein.
- Right lobe of the liver and right kidney for textural comparison view
- Include a near coronal plane and view dome of right lobe and right hemi diaphragm and right pleural space – record if any pleural effusion or sub diaphragmatic fluid seen
- Longitudinal views of gallbladder – include neck and cystic duct
- CBD – with measurements, attempt to lay out duct in longest axis (measure over portal vein and largest areas) Image with color Doppler in the portal vein to verify duct.
- Longitudinal view of right kidney with calipers – scan from medial, hilum to lateral margins
- Portal vein, right and left (direction of flow if patient has known liver disease)

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- **IMPORTANT:** Document direction of flow in the portal vein on all patients using Doppler and color imaging.

**TRANSVERSE SCANS:**

- Left lobe of liver with left portal vein, the ligamentum teres
- The confluence of the hepatic veins using a subcostal approach
- Hepatic artery as it travels towards liver
- MV and SMA to demonstrate head and uncinate process of pancreas
- Attempt to view entire pancreas checking for size of pancreatic duct and CBD
- If possible, transverse of GDA and CBD for lateral margin of head
- Multiple scans through right lobe include hepatic vasculature, parenchyma and gallbladder
- Multiple scans through the right kidney (upper, mid, lower pole)

**LEFT DECUBITUS VIEW TO INCLUDE:**

- Gallbladder, always include one other position such as decubitus, erect or prone
- CBD if not seen adequately
- Right kidney liver parenchyma
- Sweep through liver particularly right lobe

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## ABDOMINAL COMPLETE

### DATE OF EDIT:

April 24, 2020

### INDICATION:

See order disambiguation above

### PREP:

Prep – NPO for 6 to 8 hours before examination (clear liquids and medications allowed if patient is diabetic). Infants should be NPO for two hours.

### REVIEW:

The technologist should review pertinent previous ultrasound, computed tomography, and nuclear medicine images and/or reports. Pay particular attention to previous exams which prompted the current study. For example, the technologist should pick up the fact that the ultrasound of the kidneys was recommended by the radiologist who was interpreting a CT of the abdomen. The technologist should review the CT exam and, after performing the ultrasound, should note the findings about the particular lesion in question.

### HISTORY NOTE:

Note the type of pain, location, duration, and association with certain foods. Note abnormal lab values if available. Note palpable abnormalities. Search for metastatic disease or neoplasm.

### IMAGING:

Begin with patient supine and scan epigastrium

### LONGITUDINAL SCANS:

- Midline view of aorta to include 1 prox. 1 mid, and 1 distal diameter measurement.
- Left lobe of liver with ligamentum teres and left portal vein, but ensure the left lobe is scanned beyond its margins
- Image IVC and caudate lobe – caudate lobe size
- Multiple scans of right lobe with vasculature (hepatic and portal veins, demonstrate the direction of flow with Doppler of the portal vein.
- Right lobe of the liver and right kidney for textural comparison view
- Include a near coronal plane and view dome of right lobe and right hemidiaphragm and right pleural space – record if any pleural effusion or subdiaphragmatic fluid seen
- Longitudinal views of gallbladder – include neck and cystic duct
- CBD – with measurements, attempt to lay out duct in longest axis (measure over portal vein and largest areas) Image with color Doppler in the portal vein to verify duct.

- Pancreas – Image all portions of pancreas whenever possible, Include parenchymal abnormalities, distal CBD at region of head and pancreatic duct for dilatation.
- Longitudinal view of both kidneys with calipers – scan from medial, hilum to lateral margins
- Longitudinal and transverse view of spleen to include left pleural space. Measure spleen cranio-caudad dimension.
- Portal vein, right and left (direction of flow if patient has known liver disease)
- Longitudinal views of urinary bladder – even if bladder is empty
- **IMPORTANT:** Document direction of flow in the portal vein on patients with portal hypertension, splenomegaly, chronic hepatitis and cirrhosis of the liver using Doppler and color imaging.

## TRANSVERSE SCANS:

- Left lobe of liver with left portal vein, the ligamentum teres
- The confluence of the hepatic veins using a subcostal approach
- Hepatic artery as it travels towards liver
- MV and SMA to demonstrate head and uncinate process of pancreas
- Attempt to view entire pancreas checking for size of pancreatic duct and CBD
- If possible, transverse of GDA and CBD for lateral margin of head
- Multiple scans through right lobe include hepatic vasculature, parenchyma and gallbladder
- Multiple scans through both kidneys (upper, mid, lower pole)
- One image of bladder/pelvis even if bladder is empty

## LEFT DECUBITUS VIEW TO INCLUDE:

- Gallbladder, always include one other position such as decubitus, erect or prone
- CBD if not seen adequately
- Right kidney liver parenchyma
- Sweep through liver particularly right lobe

## \*\*\*NOTE\*\*\*

- Gallbladder ultrasound would include images of the gallbladder and biliary tree
- A brief survey of the abdominal aorta should be included in an abdominal ultrasound. If pathology is seen a dedicated aortic ultrasound exam could be recommended.

## IMAGING NOTE:

See instructions for individual organs. WNL is acceptable.

## **TIPS (Transjugular Intrahepatic Portosystemic Shunt) Protocol**

### **DATE OF EDIT:**

August 18, 2016

### **INDICATION:**

To ensure the shunt is working properly and that no stenosis has occurred within the stent.

### **PREP:**

Prep – NPO for 6 to 8 hours before examination

### **REVIEW:**

The technologist should review pertinent previous ultrasound, computed tomography, and nuclear medicine images and/or reports. Pay particular attention to previous exams which prompted the current study.

### **HISTORY NOTE:**

Note history of liver disease. Note history of ascites. Note history of date and location of TIPS procedure. Note abnormal lab values if available.

### **IMAGING:**

Begin with patient supine and then decubitus

### **TRANSVERSE SCANS:**

- Liver with all 3 hepatic veins
- Liver with main port vein

### **SAGITTAL SCANS:**

- Left lobe of liver with proximal aorta
- Liver with IVC
- Right lobe of liver with right portal vein
- Liver/Kidney interface

### **COLOR DOPPER and PW images of the following to assess patency and direction of flow:**

- Proximal IVC
- Portal vein just proximal to its communication with TIPS shunt
- Junction of portal vein and TIPS
- Proximal, mid and distal sections of TIPS
- Junction of hepatic vein and TIPS (if possible, may be difficult)
- Hepatic vein just distal to its communication with TIPS (if possible, may be difficult)
- All port veins should be imaged for flow direction



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**\*\*\*IMAGING NOTE\*\*\***

- Presence of thrombus in any vessel

**When exam is completed mark it as a consult for an interventional radiologist to dictate.**

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## ULTRASOUND OF THE ABDOMINAL AORTA WITH DOPPLER EVALUATION

### DOCUMENT REVISION DATE:

May 18, 2022

### INDICATION:

Pulsatile abdominal mass. Follow up AAA

### PREP:

Prep – NPO for 6 to 8 hours before examination (clear liquids and medications allowed if patient is diabetic).

Patients can be done with less NPO time if needed, but the time that the patient was NPO should be noted in the history.

### HISTORY NOTE:

Please note whether or not this is a follow up exam, the date of any previous exam, screening exam, and the reported size of the AAA on the previous exam.

### REVIEW:

The technologist should review pertinent previous ultrasound or computed tomography images and/or reports. Pay particular attention to previous exams which prompted the current study.

### IMAGING:

1. Image the aorta transversely with measurements at the proximal, mid and distal levels.
2. Image the aorta longitudinally at the proximal, mid and distal portions with measurements.
3. Demonstrate iliac bifurcation. Show a longitudinal image of the right and left iliac arteries with AP measurements and transverse images of proximal iliac at bifurcation.
4. Take an image of the proximal and distal abdominal aorta with color and pulsed wave Doppler using the appropriate angle Doppler.
5. Measure and document any pathology.
6. Measurements should be from outer wall to outer wall of the vessel and perpendicular to long axis of aorta. If aneurysm is present, measure its length.
7. Relationship to renal arteries should be demonstrated if possible.

### IMAGING NOTE:

Note the maximum diameter of aorta perpendicular to the central axis of the vessel and note the location of this maximum diameter (mid, distal, etc.). Note if thrombus is present.

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## ULTRASOUND SCREENING EXAMINATION FOR ABDOMINAL AORTA

### DOCUMENT REVISION DATE:

October 2023

### INDICATION:

Screening AAA – Men 65 years or older, women 65 years or older with cardiovascular risk factors, men or women over 50 with personal hx of vascular aneurysmal disease. Also, patients over 65 with hx smoking or HTN.

### PREP:

Prep – NPO for 6 to 8 hours before examination (clear liquids and medications allowed if patient is diabetic).

### HISTORY NOTE:

Please note that this is a “Screening Exam” and the associated risk factors in RIS.

### REVIEW:

The technologist should review pertinent previous ultrasound or computed tomography images and/or reports.

### IMAGING:

1. Longitudinal and transverse images of the suprarenal proximal aorta above the celiac axis labeled prox suprarenal aorta.
2. Longitudinal images of the proximal, mid and distal portions of the infrarenal aorta above the iliac bifurcation. AP measurements to be taken at each level. Should be labeled infrarenal prox, mid and distal.
3. Transverse images of the proximal, mid and distal portions of the infrarenal aorta above the iliac bifurcation, AP measurements should be taken at each level.

### IMAGING NOTE:

Report if an aneurysm is present in your impression notes, as well as the maximum diameter of the aorta perpendicular to the central axis of the vessel. Color and Doppler images are NOT to be performed as part of the screening exam.

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## RENAL ULTRASOUND

### DOCUMENT REVISION DATE:

November 22, 2013

### INDICATIONS:

Typical indications include renal failure or insufficiency (looking for hydronephrosis), pediatric UTI (looking for hydronephrosis), or mass or hematuria (looking for mass).

### PREP:

No prep required HISTORY

### NOTE:

If a previous study such as CT prompted the ultrasound, be sure to indicate.

### REVIEW:

The technologist should review pertinent previous ultrasound or computed tomography images and/or reports. Pay particular attention to previous exams which prompted the current study. Lab values should be noted if available.

### IMAGING:

#### LONGITUDINAL SCANS:

- Start medially scan through kidney include visualization of renal cortex and pelvis
- Longitudinal measurement of kidney with and without calipers
- Peri-renal area should be assessed for abnormalities
- Image of each kidney with liver/spleen to compare echogenicity

#### TRANSVERSE SCANS:

- Begin at upper pole scan through the lower pole
- Image upper, mid and lower pole
- Measure prostate gland if seen while screening the urinary bladder

Bladder – include images of the bladder and its wall, both longitudinally and transversely on all renal studies. Attempt to image the UVJ's at oblique insertion.

If hydronephrosis is present reimage the kidney after the patient voids. Check bladder post-void and measure if it is still distended.

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When imaging the patient with a renal transplant use the proceeding protocol. However, document the location of the kidney (i.e., pelvic kidney) and document the presences of arterial and venous blood flow. Also document any perirenal fluid collections and the presence of hydronephrosis. Evaluate both the transplanted and nature kidney and fossa.

**IMAGING NOTE:**

Note any abnormalities. If stones or cysts are present, indicate a general number for each kidney. For example, two right and one left small stone. WNL is acceptable.

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## URINARY BLADDER

### DOCUMENT REVISION DATE:

May 18, 2022

### INDICATIONS:

Bladder outlet obstruction.

### HISTORY NOTE:

Note any history of UTI or bladder outlet obstruction or prostate cancer. Note pertinent surgical history such as bladder suspension or prostatectomy.

### REVIEW:

Depending on the history, the technologist should review pertinent previous ultrasound or computed tomography images and/or reports. Pay particular attention to previous exams which prompted the current study.

### PREP:

Full urinary bladder

### IMAGING:

Patient's bladder examined in longitudinal and transverse planes, to exclude

- Thickened (irregular) wall
- Diverticula
- Calculi/particularly at ureterovesicle junction
- Dilatation of distal ureteral junctions.

Calculate and pre- and postvoid bladder volume by measuring bladder in the three planes

Measure the bladder wall

The full urinary bladder is used as an acoustic window to view the prostate and seminal vesicles

The probe may need to be angled inferiorly with some probe pressure to maintain contact and gain adequate views of the prostate

Request that the patient obtain a post-void residual volume of the bladder calculated by measuring the bladder in three planes

Assess the urinary bladder for calculi and assess the urterovesicle junction for obstructive calculi--- color Doppler can assist to see ureteric jets

(A separate renal ultrasound order must be obtained). Do a scan of kidneys if necessary due to



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## MALE PELVIC (Transabdominal)

### DOCUMENT DATE:

May 21, 2018

### INDICATIONS:

Male pelvic and groin pain.

### PREP:

Same as female pelvis. 32 oz fluid 1 hour prior to appointment time.

### HISTORY NOTE:

Note location of pain and to what degree. Note length of pain. Note any palpable masses. Note if any injury to area. Note any urination problems.

### REVIEW:

Technologist should review any previous pertinent studies, such as ultrasounds or CT scans of the pelvic.

### IMAGING:

With patient supine.

Midline image showing distended bladder. Image left of midline until bladder is no longer visible. Repeat with right.

Transverse images from base of bladder superiorly to bladder no longer visible.

Image over any area of pain or palpable mass.

Measure pre and post void bladder. Measure thickness of bladder wall.

Measure prostate at widest dimension.

### FINDINGS NOTE:

Include comment about any palpable masses seen and bladder wall measurement.

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## PEDIATRIC KIDNEYS/BLADDER ULTRASOUND

### DOCUMENT REVISION DATE:

November 22, 2013

### INDICATIONS:

UTI (looking for hydronephrosis)

### PREP:

No prep required

### HISTORY NOTE:

If a previous study such as CT prompted the ultrasound, be sure to indicate.

### REVIEW:

The technologist should review pertinent previous ultrasound or computed tomography images and/or reports. Pay particular attention to previous exams which prompted the current study.

### IMAGING:

Use a 7.0 - 9 MHz transducer depending on age and size. Uses highest frequency transducer possible to obtain image

Longitudinal and transverse views also at least 3 longitudinal views and 3 transverse images (sup, med and inferior poles), length measurement and cortical thickness

Obtain images of the urinary bladder... which should be reasonably full

For longitudinal measurements, prone position gives optimal images, but obtain decubitus views if necessary, to adequately view the entire kidney

If the renal pelvis seems dilated when the patient's bladder is full, have the patient empty their bladder and take additional views

### IMAGING NOTE:

Note the presence or absence of hydronephrosis or any other abnormalities.

## **PYLORIC STENOSIS**

### **DOCUMENT REVISION DATE:**

November 22, 2013

In the case of hypertrophic pyloric stenosis, the thickened muscle mass is seen as a hypoechoic layer just superficial to the more echogenic mucosal layer of the pyloric canal. In cross-section, this “olive” (on clinical palpation) resembles a sonolucent doughnut medial to the gallbladder and anterior to the right kidney.

### **INDICATIONS:**

Excessive vomiting or spitting up, often accompanied with weight loss in an infant.

### **PREP:**

NPO for 3 hours.

**HISTORY NOTE:** Note age of patient, sex of patient, symptoms and weight loss.

### **TECHNIQUE:**

- Use a high frequency linear array transducer e.g. 9 MHZ
- Sagittal image of the abdomen showing a target or doughnut appearing mass. The central part of the mass appears more hyperechoic than the surrounding wall
- Transverse image of the mid abdomen, showing the liver anterior to the elongated mass. Antrum of the stomach is seen on the right of the image and the distal pylorus on the left. Pylorus should be located medial to the gallbladder and anterosuperior to the pancreatic head

### **SONOGRAPHIC CRITERIA:**

- Elongated pylorus; pyloric canal length, from the gastric antrum to the end of the pyloric canal
- Doughnut sign, hyperechoic lumen, thickened wall muscle
- Double/triple track sign in cross-section

### **PITFALL:**

“Oblique scan” due to posterior location of pylorus and as a result false thickening.

Ask attending Radiologist if they want the patient scanned with a full stomach (use water in a bottle from the x-ray department)

**IMAGING NOTE:** Note length of pyloric canal as well as muscle thickness. Try to review case with a radiologist if you are unsure.

## APPENDICITIS

### DOCUMENT REVISION DATE:

August 18, 2008

**INDICATION:** Severe RLQ pain. Abnormal labs.

**PREP:** None.

**HISTORY NOTE:** Note type, duration and location of pain. Note any other pertinent studies. Note any abnormal labs.

**REVIEW:** Review prior studies.

**IMAGING NOTE:** Note measurement of the appendix. Note any free fluid, cystic or complicated fluid collections.

### ANATOMY:

- Vermiform appendix is a long tubular structure arising from the cecum
- It has the same 4 layers as the rest of the large intestine and these give it a characteristic signature on sonograms

### PATHOLOGY:

- The underlying cause of appendicitis is poorly understood
- It may begin as mucosal ulceration or obstruction to the lumen, but there is a rapid progression to transmural inflammation
- Extension of this inflammation to the serosal or outer layer of the appendix causes a secondary inflammatory response on the mesoappendix and surrounding fat
- Inflamed fat is an important feature of advanced appendicitis and is well documented with ultrasound

### TECHNIQUE:

- Use a high frequency linear transducer
- Start with graded compression over the area of maximal tenderness
- Identification of the cecum, terminal ileum, iliac vessels, and iliacus muscle are helpful landmarks for the identification of the appendix
- The appendix originates from the tip of the cecum and is usually located inferior and slightly medial to the cecum (though this position can be quite variable)
- Longitudinal and transverse images of the appendix should be obtained and an AP measurement should be documented
- Images of the tip of the cecum and the terminal ileum should be included



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- Demonstrate the entire length of the appendix to rule out any segmental appendicitis
- Color Doppler may be helpful to demonstrate hyperemia. However, if the appendix is gangrenous flow will not be present
- Demonstrate the blind end of the appendix to confirm anatomy.

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## APPENDIX

If any ordering physician calls to add on an ultrasound of the appendix, please do the following:

- Try to explain that unless it is a young child, a CT scan is the better examination for appendicitis
- If the study is positive, we would probably still need a CT scan to confirm and look for an abscess
- If the exam is negative, it will not rule out a positive appendicitis. Therefore, leading the patient to require a CT scan anyways

However, if the doctor insists, please scan the region of interest.

### PROTOCOL:

Perform scan of the RLQ, localize the region of the appendix and image in both the longitudinal and transverse planes



## Thoracentesis/Paracentesis Procedure Notes

- (1) – Sterile Gloves – 7 ½
  - (1) – Mask
  - (1) – Sterile Field
  - (1) – Chloraprep (one on tray, 2 available)
  - (1) – Fenestrated Drape
  - (1) – Lidocaine
  - (1) – Filter Needle (if glass ampule) or 18ga (if rubber stopper vial)
  - (1) – 5/8” Needle
  - (1) – 1 ½” Needle
  - (1) – 10cc Syringe
  - (1) – Scalpel
  - (1) – Yueh Needle
  - (1) – 60cc Syringe
  - (1) – Tubing
  - (1) – Suction Bottle
  - (1) – 60cc regular top syringe
- Specimen containers depending on lab orders

\*Paperwork pertaining to procedure will be completed by department nurse and ultrasound staff. Necessary forms are located on the RAO intranet, under Paracentesis.

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## SHEAR WAVE LIVER ELASTOGRAPHY

**Indications:** Fibrosis staging of chronic liver disease, such as Hepatitis B and C, fatty liver disease, primary biliary cirrhosis, etc.

**Prep:** NPO 4-6 hours prior to exam

**History Notes:** Any history of liver disease and related treatment, elevated liver function test. Liver biopsy results if previously performed.

**Exam:** First perform a complete study of liver including Doppler. Then position the patient supine with right arm extended over the head to maximize intercostal space. Scan intercostally, applying pressure to the probe at the level of segment 7 or 8 of the liver. Top of shear wave box should be 1-2cm below liver capsule with the middle of the shear wave box between 3-6cm. Scan using a breath hold technique- DO NOT use inspiration. Avoid rib shadows and vessels. Perform 10 individual measurements. Program will calculate liver stiffness in kPa units. Refer to staging chart for kPa values and degrees of liver stiffness.

Refer to product manual for performance and troubleshooting as needed.

**Imaging Note:** Note that exam is a Liver with Shear Wave Elastography in the history section of the notes.

### **PROTOCOLS FOR THE FEMALE PELVIS**

1. Female pelvic – transabdominal ultrasound
2. Transvaginal ultrasound
3. Early pregnancy
4. First trimester obstetrical protocol
5. Second and third trimester obstetrical protocol
6. Amniotic fluid index and chart
7. Biophysical profile \*
8. Fertility (transvaginal only)

### **PROCEDURES**

1. Sonohysterography

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## FEMALE PELVIS

**REVISION:** October 2023

**INDICATIONS:** Pelvic pain, dysmenorrhea, amenorrhea, menorrhagia, metrorrhagia, f/u previous abnormality, infertility, delayed menses or precocious puberty, post-menopausal bleeding, abnormal or limited pelvic examination, signs of pelvic infection, congenital abnormalities, complications post-surgery, delivery or abortion, location of intrauterine device, screening for high-risk patients, urinary disorders, guidance for procedures.

### PREP:

The appropriate preparation for a pelvic scan is a full bladder. Ideally the patient should finish drinking 32 to 40 ounces of water 1 hour before their examination time. The bladder should be adequately distended to displace the small bowel from the field of view.

- Transvaginal studies are performed – particularly when it is the more efficient diagnostic technique (in addition to the transabdominal scan) this should be done with an empty urinary bladder
  1. inadequate bladder filling
  2. some follow up studies
  3. any woman with abnormal/dysfunctional bleeding i.e. for endometrial thickness
  4. any pregnancy patient where an IUP is not visualized
  5. where an adnexal mass is seen (TAS) which is not a classic simple cyst/or hemorrhagic cyst---for better characterization of the lesion
  6. assessment of retroverted/retroflexed uterus

### HISTORY NOTE:

- Ideally the LMP should always be included as relevant clinical detail and recorded
- Note patient's symptoms and any region of pelvic pain
- Note phase of menstrual cycle

**REVIEW:** Prior studies and relevant lab values.

**IMAGING:** All relevant structures should be identified by either a transabdominal or endovaginal approach, often both are required.

### Longitudinal scan:

Starting at 1 side e.g., left – scan through to the other side, documenting uterine orientation, shape and contours, myometrium, endometrium cervix and vagina...image both ovaries in longitudinal plane and assess the Pouch of Douglas...always record a midline image

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### Measurements:

- Uterine length from the fundus to the cervix and the AP diameter in the same image.
- Endometrium should be evaluated for thickness, focal abnormality and presence of fluids or masses. The endometrium should be measured on a midline sagittal image including anterior and posterior portions of the basal endometrium and excluding the adjacent hypoechoic myometrium or any endometrial fluid.
- Length, width and depth of ovaries in 2 orthogonal planes
- Evaluate myometrium
- Evaluate and image cervix
- Please consider the phase of the patient’s menstrual cycle; further evaluation may be necessary through Sonohystography.
- Abnormalities should be measured and documented, noting contour changes, echogenicity, masses and cysts. Masses should be measured in at least two dimensions. It is not necessary to measure all fibroids.
- The adnexal regions should be evaluated for any abnormalities including tubular structures or masses.
- Cul-de-sac and bowel posterior to uterus should be evaluated for mass

### Transverse scan:

Begin at the vagina and scan through the uterus cephalic to the fundus. Label film “transverse” fundal/mid/cervix

### Measurements:

- Width of the uterus obtained in the transverse plane
- Ovarian width obtained in the transverse plane
- The area of the cul-de-sac should be evaluated

### Doppler:

Pulsed wave Doppler is to be used to document arterial and venous blood flow in both ovaries. Where applicable color and spectral Doppler can be utilized to demonstrate the vascularity of a mass or a cyst. If this is not obtainable due to patient age, body habitus, oophorectomy, etc... document so in Synapse. Doppler imaging must be performed both transabdominally and transvaginally on both ovaries as seen. Doppler imaging performed only with receipt of physician order. If the order does not state to Doppler and the exam is not for pain, you do not have to Doppler. If the exam is for pain, we must obtain a Doppler order.

**HISTORY NOTE:** Note any regions of pelvis pain. LMP should be noted. If available lab values or corresponding exams should be noted. Note should be made as to whether a patient is post menopausal, any irregular menses should be noted, no phase or menstrual cycle. Review any prior studies.

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**IMAGING NOTE:** Note any pelvic pathology seen. Comment on ovarian cyst appearance as well as if a septation or mural nodule is seen. WNL is acceptable if appropriate.

Note absence or presence of blood flow to and from the ovaries as well as if this was not able to be obtained.

- Note IUD presence and position.

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## TRANSVAGINAL ULTRASOUND

### DOCUMENT REVISION DATE:

October 2023

**INDICATION:** These studies are performed in the following circumstances:

1. Anytime an ordering physician orders this exam (except if the patient is a virgin and does not consent)
2. If it is deemed a more efficient diagnostic technique to reach a diagnosis.
3. If a patient is incapable of adequate bladder filling.
4. In cases of follow up examinations.
5. To evaluate endometrial abnormalities.
6. Anytime that a patient presents with a pregnancy that does not demonstrate an IUP.
7. For clarification of adnexal masses seen transabdominally (for characterization of the lesions)
8. Better assessment of the uterus with a deviated position.

**PREP:** Empty urinary bladder

**HISTORY NOTE:** Note patient's symptoms, any regions of pelvic pain. LMP should be noted. If available, report any corresponding exams or lab values. Note phase of menstrual cycle.

**IMAGING:** All relevant structures should be identified by either a transabdominal or endovaginal approach, often both are required

### Longitudinal scan:

Starting at 1 side e.g., left – scan through to the other side, documenting uterine orientation, shape and contours, myometrium, endometrium cervix and vagina...image both ovaries in longitudinal plane and assess the Pouch of Douglas...always record a midline image

### Measurements:

- Uterine length from the fundus to the cervix and the AP diameter in the same image.
- Endometrium should be evaluated for thickness, focal abnormality and presence of fluids or masses. The endometrium should be measured on a midline sagittal image including anterior and posterior portions of the basal endometrium and excluding the adjacent hypoechoic myometrium or any endometrial fluid.
- Length, width and depth of ovaries in 2 orthogonal planes.
- Evaluate myometrium
- Evaluate and image cervix
- Please consider the phase of the patient's menstrual cycle; further evaluation may be necessary through Sonohystography.
- Abnormalities should be measured and documented, noting contour changes,

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echogenicity, masses and cysts. Masses should be measured in at least two dimensions. It is not necessary to measure all fibroids.

- The adnexal regions should be evaluated for any abnormalities including tubular structures or masses.
- Cul-de-sac and bowel posterior to uterus should be evaluated for mass.

#### Transverse scan:

Begin at the vagina and scan through the uterus cephalic to the fundus. Label film “transverse” fundal/mid/cervix

#### Measurements:

- Width of the uterus obtained in the transverse plane
- Ovarian width obtained in the transverse plane
- The area of the cul-de-sac should be evaluated

#### Doppler:

Pulsed wave Doppler is to be used to document arterial and venous blood flow in both ovaries. Where applicable color and spectral Doppler can be utilized to demonstrate the vascularity of a mass or a cyst. If this is not obtainable due to patient age, body habitus, oophorectomy<sup>30</sup>, etc... document so in Synapse. Doppler imaging performed only with receipt of physician order. Follow Doppler protocol as mentioned in “Female pelvis” protocol.

If the patient is not sexually active or a child an endovaginal exam should not be done.

Other methods could be discussed with the radiologist such as a translabial scan if necessary.

**REVIEW:** Review prior pertinent studies, paying attention to previous exams which may have prompted the current study.

**HISTORY NOTE:** Note any regions of pelvis pain. LMP should be noted. If available lab values or corresponding exams should be noted. Note should be made as to whether a patient is post menopausal, any irregular menses should be noted, no phase or menstrual cycle. Review any prior studies.

**IMAGING NOTE:** Note any pelvic pathology seen. Comment on ovarian cyst appearance as well as if a septation or mural nodule is seen. WNL is acceptable if appropriate.

Note absence or presence of blood flow to and from the ovaries as well as if this was not able to be obtained.

- Note IUD presence and position.

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**EARLY PREGNANCY –FIRST TRIMESTER (Under 14 weeks)**

**DOCUMENT REVISION DATE:**

July 17, 2017

**INDICATIONS:**

- ECTOPIC PREGNANCY
- COMPLETE VS INCOMPLETE ABORTION
- MISSED ABORTION/EMBRYONIC DEMISE
- CONFIRM CARDIAC ACTIVITY
- ESTIMATE GESTATIONAL AGE
- TO EVALUATE MATERNAL PELVIC MASSES OR UTERINE ABNORMALITIES

**PREP:** Patient should finish drinking 32 to 40 ounces of water 1 hour prior to exam.

**HISTORY NOTE:** Get a complete history to include LMP, details of pregnancy confirmation tests, onset and extent of bleeding. Sonographer should wear gloves during the examination and prepare the bed with an absorbing blue sheet or drape sheet.

**IMAGING:**

- Initially TAS scan will be performed – assess pelvis for free fluid and possible adnexal masses
- The endometrium is more accurately assessed by TVS and should be done
- TVS approach will enable a better and detailed view of
  1. decidual reaction “double decidual sign”
  2. the yolk sac and/or embryonic pole
  3. peri-sac area to rule out peri-sac bleeds

In the presence of a LIVE pregnancy test and NO IUP, the endometrium must be carefully assessed...the maximal AP diameter measured and echo texture noted. The ovaries and adnexae closely examined (preferably TVS)

Where patient refuses TVS the Sonographer should note that a TVS approach was requested by them but refused by the patient.

1. Evaluate uterus and adnexal, demonstrate absence or presence of gestational sac (location should be documented.). The presence or absence of embryo should be noted. Measure the uterine length, AP and transverse.
2. Crown rump measurement should be taken three times. If it cannot be identified, measure the gestational sac in all three planes.
3. Demonstrate absence or presence of yolk sac.
4. The presence or absence of cardiac activity should be noted.

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- a. Use only M-mode for fetal heart rate
5. Fetal number should be documented.
6. Evaluate uterus and adnexal structures and the cul-de-sac
7. If TVS probe used- Color views acceptable but do not use Doppler to evaluate ovarian flow.

**REVIEW:** Review prior pertinent studies paying attention to previous exams which may have prompted the current study.

**IMAGING NOTE:** Note should include whether a fetal pole is seen with or without heart motion. Fetal heart motion should be documented and noted. Any adnexal cyst, masses or pathology should be noted. Free fluid in the cul-de-sac should be documented and noted.

**OBSTETRICAL**

**DOCUMENT REVISION DATE:**

April 19, 2019

**PREP:** No prep required

**SECOND AND THIRD TRIMESTER PROTOCOL:**

- Assess fetal cardiac activity – document with M-mode, demonstrate a four-chamber heart
- Fetal presentation and number
- Placental position/cervical os in longitudinal plane---if possible placental edge in relationship to cervical os
- Umbilical cord should be imaged and number of vessels if possible
- Assess amount of amniotic fluid – document and measure all four quadrants if physician requests or you believe it to be abnormal
- Adnexal survey/uterine survey
- Fetal anatomy --- documentation of
  1. Stomach
  2. Both kidneys (after 15 weeks)
  3. Urinary bladder
  4. Longitudinal cervical, thoracic, lumbar and sacral spine
  5. Transverse spine (lower lumbar ossification centers)
  6. Extremity survey
  7. Three vessel cord (if not seen, then umbilical arteries around the bladder)
  8. Cross-sectional image of abdomen showing cord insertion
  9. 4-chamber heart view
  10. Profile of face and coronal image of nose and lips
  11. Choroid plexus/lateral ventricles, cerebellum, cistern magna, midline falx, cavum septum pellucid
  12. Diaphragm
  13. Demonstrate placenta location and texture and relationship to the internal os
  14. ML image of cervix
  15. Umbilical cord insertion site/ Placental cord insertion site
  16. ACR Recommends – RT and LT outflow tracts of fetal heart

**MEASUREMENTS:**

LMP is entered into database at the beginning of the exam

- Biparietal diameter
- Femur length (average of three measurements)
- Abdominal circumference (average of three measurements)
- Head circumference
- Fetal weight estimation

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**NB:**

Estimates of gestational age should be based on

- Early ultrasound if available
- CRL if in early first trimester
- LMP (if available) in the third trimester
- Multiple gestation – base estimate of gestational age on LMP

**MULTIPLE GESTATIONS:**

- Document placental number
- Number of gestational sacs
- Note presence/absence of an inter-twin membrane
- Comparison of fetal size
- Amount of amniotic fluid

**HISTORY NOTE:** Note any complications with current or prior pregnancy. Note any complaints of pain or bleeding. Review prior studies and compare fetal development with prior studies.

**REVIEW:** Prior pertinent exams.

**IMAGING NOTE:** Note any pathology seen. Note any discordance of measurements. Comment on any fetal anatomy pathology. WNL is acceptable if appropriate.

**LIMITED OB ULTRASOUND EXAMINATION:**

A limited OB exam is performed to answer a specific clinical question for management of a pregnancy. This would include specific requests for fetal weight estimate, fetal presentation, AFI, etc. If the patient has not had a previous standard OB ultrasound exam this will need to be performed first. Clinical judgement should prevail



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### OBSTETRICAL

#### **AMNIOIC FLUID INDEX PROTOCOL/TECHNIQUE:**

- Measurements are taken in longitudinal plane
- Four quadrants are assessed with the umbilicus dividing the upper and lower quadrants and the linea nigra dividing the left and right quadrants
- The transducer should be placed along the mother's longitudinal axis and held perpendicular to the floor for all the measurements
- The maximum vertical diameter of the fluid pocket is measured in each of the four quadrants
- The sum of the four quadrants in centimeters is the AFI
- Refer to enclosed chart for parameters

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### THE BIOPHYSICAL PROFILE

In addition to the routine OB ultrasound the following things should be documented:

1. Fetal breathing (FBM)
  - a. NORMAL – at least 30 seconds of substained FBM in 30 minutes
  - b. ABNORMAL – absent breathing or no breathing for >20 seconds in 30 minutes
  
2. Fetal movement
  - a. NORMAL – 3 or more movements in 30 minutes (simultaneous counts as one)
  - b. ABNORMAL - 2 or less in 30 minutes.
  
3. Fetal tone
  - a. NORMAL – at least 1 episode of limb flexion and extension and rapid return
  - b. ABNORMAL - semi or full without return or absence of movement
  
4. AFV (Amniotic Fluid Volume)
  - a. NORMAL – pocket 2 cm in 2 perpendicular planes
  - b. ABNORMAL – largest pocket < 1 cm (please refer to chart)

These should be graded on a scale from 0 to 8 with 8 being normal and 4/8 being abnormal.

**NOTE: Only send a single cine for breathing also containing selected short movement/tone cines if necessary.**

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### **FERTILITY US (FOLLICULAR - IVF MONITORING)**

**\*Perform Transvaginal US as per our written protocol\* No doppler, just a color picture of the ovaries.**

On the worksheet, please notate the patient’s exact LMP, as it is very important to assess the endometrium, as well as the follicular stage of the ovaries.

Measure the endometrial thickness and evaluate for any polyps or fibroids. Note if the endometrium is a normal thickness for stage of cycle, as follows:

- during menstruation: 2-4 mm
- early proliferative phase (day 6-14): 5-7 mm
- late proliferative / preovulatory phase: up to 11 mm
- secretory phase, after ovulation: 7-16 mm

Measure 3 follicles on each ovary, with 2 measurement average for each follicle. As well as, noting if there are numerous follicles (PCOS) or if there are less than 3 follicles on each ovary.

Start with the largest follicle (dominant follicle) and the next largest and so on. Label each follicle with a number as you are scanning. The largest will be “1” the next largest will be “2.”

Use the “US Follicular Ultrasound (IVF Monitoring)” worksheet, as well as the normal pelvic worksheet and scan both into your study.

**\*\*These studies are only done as a transvaginal US, as it the best way to evaluate the endometrium, as well as the number of ovarian follicles.**

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## SONOHYSTEROGRAM

Set out for the radiologist the appropriate size sterile gloves and the headlight.

On a separate mayo stand or counter set up the following items in a sterile manner.

- a. hystero tray – single use disposable tray in x-ray
- b. 1 – 10cc syringe filled with sodium chloride
- c. 1 – 3cc syringe filled with sodium chloride (for filling the catheter balloon)
- d. 1 – 20 cc syringe filled with sodium chloride
- e. HSG catheter, 5F/7F
- f. 2 – bottles Sodium Chloride
- g. Headlamp
- h. Sterile gloves
- i. Betadine

Perform an endovaginal ultrasound with the regular protocol for that exam.

Have the patient sit up and empty bladder again if necessary.

Show images to radiologist and give patient's history.

After the radiologist speaks with the patient, they should fill the catheter balloon with water to remove any air bubbles. When this is completed, you may have the patient lie down and place their feet in the stir-ups. After the radiologist places the catheter, the speculum must be removed. With the endovaginal probe in place find a sagittal image of the endometrium. The radiologist will then fill the endometrium with the saline, distending the endometrial canal. Multiple images should be obtained in both sagittal and coronal planes.

An endometrial measurement should be obtained. Upon removal of the catheter a few images should be taken of the endometrial canal.

The radiologist will exit.

At this time, you should instruct the patient that mild bleeding and cramping should be expected. Anything severe including a fever should be reported to the patient's physician, or to us if they cannot be reached.

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### **PROTOCOLS FOR SMALL PARTS SCANNING**

1. Scrotal Ultrasound
2. Thyroid, Cervical Lymph Nodes, Soft Tissue Head or Neck and Parathyroid
3. Infant hips
4. Thyroid Fine Needle Aspirations
5. Pyloric Stenosis
6. Infant Spine

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## SCROTAL ULTRASOUND

**DOCUMENT REVISION DATE:** April 2023

**PREP:** None.

**HISTORY NOTE:** Note type and location of pain or palpable abnormality. Note any history of surgery or testicular trauma. Comment on any personal history of cancer. Evaluation of potential hernia. Localization of undescended testes.

### IMAGING TECHNIQUE:

- Place a towel across the thighs with patient supine
- High frequency (7MHz or greater) linear array transducer
- An ample amount of gel should be used in order to avoid undue pressure on the scrotum
- Gray scale study includes longitudinal and transverse images with diameter measurements of the testis, display of the epididymis & longitudinal view of the spermatic cord. Comparable views should be obtained from each testis whenever possible
- High resolution Doppler ultrasound with color and spectral assessment is an integral part in each scrotal sonogram. Document flow with color and spectral Doppler, arterial and venous images of both testes.
- Optimize the signal processing using the lowest velocity scale possible, decreasing wall filters, magnifying the field of view and increasing the flow persistence to maximum values
- Obtain longitudinal images of the testicle at the medial, mid and lateral regions. Take measurement of the testicle in the mid portion of the organ
- Obtain transverse images of the testicle in the superior, mid and inferior planes with a transverse measurement at the mid pole.
  - Include side by side image of testes.
  - Include side by side image of testes using color Doppler.
- Take images of both epididymis
- Use Valsalva maneuver to document varicoceles
- Display testicular anatomy and angioarchitecture of a solid or complex cystic palpable hypervascular lesion
- Evaluate scrotal skin thickness

Gray scale sonography identifies varicoceles as dilated (>2mm) veins in the peritesticular tissue. Spectral and color Doppler is performed with Valsalva induced flow augmentation. Demonstrate venous blood flow to rule out torsion and arterial flow if possible.

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**REVIEW:** Any pertinent studies.

**IMAGING NOTE:** Note any testicular pathology seen. Comment on vascular flow to the testicles. Document and comment on any extratesticular pathology seen, i.e. epididymal cyst, varicoceles, etc.

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**THYROID, CERVICAL LYMPHNODE, SOFT TISSUE HEAD OR NECK AND PARATHYROID**

**DOCUMENT REVISION DATE:**

April 19 2019

**INDICATION:** Thyroid nodule, abnormal prior studies. Palpable neck masses. Localization of parathyroid abnormalities in patients with hyperparathyroidism.

**PREP:** None.

**IMAGING PROTOCOL:**

Patient lies supine, with some neck hyperextension if well tolerated by the patient. High frequency/high resolution linear-array transducer.

**LONGITUDINAL:**

- Scan through both lobes – label medial, mid and lateral
- Measure length at the best longitudinal level

**TRANSVERSE:**

- Scan through the ISTHMUS and scan both lobes, from upper to lower pole. Measure thickness in one view.
- Label isthmus, trans, sup, mid, inf and trans thyroid sup, med, inf.
- Measure mid pole AP and width
- Evaluate and document appearances (if any) of retrosternal extension of lower pole thyroid. Caudal angulation may be necessary
- Evaluate surrounding gland for parathyroid nodules

Measure dominant focal lesions (2 to 3) in 3 dimensions.

Use color Doppler/power Doppler to assess and demonstrate focal lesion perfusion

Image transverse with both lobes viewed to show comparative view of size and echogenicity of both lobes

**REVIEW:** Correlation with previous US scan or Nuclear Medicine scan is valuable

**HISTORY NOTES:** Note if the patient is on thyroid medication Note

if patient has history of radiation therapy or cancer.

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**CERVICAL LYMPH NODE EVALUATION:**

Evaluate lymph nodes as directed in physician order, per location, patient symptoms, etc. This will vary per patient.

- Document size and location of any nodes that appear abnormal.
- Document any unusual features such as absence of hilum.
- Perform color flow views

Pediatric patients are often referred for acute lymphadenitis.

- Document as above, size, echogenicity and vascularity

**SOFT TISSUE HEAD OR NECK:**

Evaluate any palpable lump or mass on the head and neck as directed per physician order.

Include information regarding the location and duration of the lump and any pertinent patient history.

**\*\*PARATHYROID\*\* Patient must have prior Sestamibi nuclear scan with available report.**

Image region of anticipated parathyroid glands (upper pole, lateral or posterior thyroid/lower pole of thyroid lateral or posterior).

When visualized document size and number (in at least 2 – prefer 3 planes)

IMAGING NOTE: Note if thyroid lobe is enlarged, note general number of thyroid nodules or cysts. Note other pathology seen incidentally.

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**ULTRASOUND IN THE DIAGNOSIS OF HIP JOINT EFFUSIONS IN SMALL CHILDREN**

**POSITION:**

Supine, neutral hip position

Scanning performed from the anterior aspect of the hip, longitudinally along the shaft of the femoral neck

Comparison made with the asymptomatic hip

In the normal hip, the thickness of the capsule from the outer margin to the cortex of the femoral neck usually measures from 2 to 5 mm.

**In the abnormal hip, when effusion is present:**

- The capsule becomes distended
- Fluid can be seen, and can contain low level echoes indicative of inflammation or hemorrhage
- Fluid can be anechoic and hypoechoic in toxic synovitis and more echogenic in septic arthritis
- If the fluid is anechoic, septic arthritis can be excluded
- NB other investigators have found the sonographic characteristics of the fluid to be nonspecific

**RADIOGRAPHY IS PREFERRED AFTER THE AGE OF 6 MONTHS**

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**PROCEDURE: THYROID FINE NEEDLE ASPIRATION BIOPSY:**

Standard supplies:

- Sterile fenestrated drape
- Sterile gauze pads
- Betadine prep swabs
- (3) 10cc syringes
- (2) 25 ga 1 ½ needles
- (1) 21ga needle
- Lidocaine
- Probe cover
- Aspirate cytology solution

Glove sizes: Size 8

**INDICATION:** Dominant thyroid nodule

**PRIOR STUDIES:** Prior studies needed prior to aspirate being performed.

- Thyroid ultrasound and/or Thyroid nuclear study
- Thyroid function test (would need only if already performed)

If patient has not had a prior thyroid ultrasound in last 3 months, we would need an order for a thyroid ultrasound as well as an order for the aspirate. The thyroid ultrasound would be performed prior to the aspirate.

**CHECK CONSENT FORM FOR PATIENT SIGNATURE AND WITNESS SIGNATURE**

- Locate area of concern and mark
- Elevate table to working height of Radiologist
- Have probe cover ready and cover probe for procedure

**Syringes with needles that have been used should be placed in the sharp’s container, DO NOT RECAP AND/OR REMOVE USED NEEDLES FROM SYRINGES.**

## **PYLORIC STENOSIS**

### **DOCUMENT REVISION DATE:**

August 18, 2008

In the case of hypertrophic pyloric stenosis, the thickened muscle mass is seen as a hypoechoic layer just superficial to the more echogenic mucosal layer of the pyloric canal. In cross-section, this “olive” (on clinical palpation) resembles a sonolucent doughnut medial to the gallbladder and anterior to the right kidney.

### **INDICATIONS:**

Excessive vomiting or spitting up, often accompanied with weight loss in an infant.

**PREP:** NPO for 3 hours.

**HISTORY NOTE:** Note age of patient, sex of patient, symptoms and weight loss.

### **TECHNIQUE:**

- Use a high frequency linear array transducer e.g., 7 MHZ
- Sagittal image of the abdomen showing a target or doughnut appearing mass. The central part of the mass appears more hyperechoic than the surrounding wall
- Transverse image of the mid abdomen, showing the liver anterior to the elongated mass. Antrum of the stomach is seen on the right of the image and the distal pylorus on the left. Pylorus should be located medial to the gallbladder and anterosuperior to the pancreatic head

### **SONOGRAPHIC CRITERIA:**

- Elongated pylorus; pyloric canal length, from the gastric antrum to the end of the pyloric canal
- Doughnut sign, hyperechoic lumen, thickened wall muscle
- Double/triple track sign in cross-section

### **PITFALL:**

“Oblique scan” due to posterior location of pylorus and as a result false thickening.

Ask attending Radiologist if they want the patient scanned with a full stomach (use water in a bottle from the x-ray department)

**IMAGING NOTE:** Note length of pyloric canal as well as muscle thickness. Try to review case with a radiologist.

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## INFANT SPINE

### DOCUMENT REVISION DATE:

July 17, 2017

### INDICATION:

- Lumbosacral stigmata such as skin tags, skin discolorations, hemangiomas, dimples, or masses
- Suspected cord anomalies
- Caudal Regression Syndrome

PREP: None

### IMAGING PROTOCOL:

#### LONGITUDINAL/SAGITAL

- Obtain in midline with infant prone.
- Examine Lumbosacral region for normal cord morphology
- Level of termination of conus should be assessed and documented. Determine level of termination of cord.

#### TRANSVERSE:

- Examine individual vertebral bodies for motion of nerve roots

### VASCULAR ULTRASOUND PROTOCOLS

1. Carotid
2. Upper extremity venous Doppler
3. Lower extremity venous Doppler
  - a. Research protocols and worksheets
4. Doppler surveillance of LE bypass grafts and femoral to femoral bypass grafts
5. Venous Insufficiency
6. Protocol for stent evaluation (TIPS)
7. Segmental Arterial Exam Protocol – Stress and Non-stress
8. Upper/Lower Extremity Arterial Protocol with Segmental and Duplex Imaging

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## CAROTID ULTRASOUND

**DATE OF EDIT:** May 18, 2022

**INDICATION:** History of carotid stenosis, cervical bruit, hemispheric neuralgic symptoms. Dizziness, visual disturbances, symptoms of CVA or TIA, pulsatile neck masses.

**PREP:** None.

**HISTORY NOTE:** Note prior arterial procedures and/or surgeries. Note symptoms leading to the performance of the examination.

**REVIEW:** Review any prior vascular imaging studies such as prior carotid ultrasounds, MRI's and arteriograms.

**TECHNIQUE:** The course of CCA, ICA. ECA and vertebral arteries should be evaluated from their origins to as far distally as possible. Both sides must be examined. Where possible the origins of the subclavian arteries should also be examined.

Carotid artery examinations are performed with the patient supine, the neck extended (if well tolerated) and the head turned away from the side being examined.

- Begin with the left side in the transverse plane at the supraclavicular notch, identify the origin of the CCA and attempt to view the subclavian artery origin as well
- Follow the carotid artery cephalad to the angle of the mandible; note the point of CCA bifurcation and establish the orientation of the internal and external carotid arteries, this helps to define the optimal longitudinal plane for spectral analysis.
- Grayscale imaging may visualize plaque disease and extent
- Color flow mapping will demonstrate points of significant hemodynamic turbulence. Color Doppler will assist in delineating the direction of the stenotic jet e.g., eccentric jet--- and enable optimal angle of assessment of spectral data. Never take spectral waveforms at angles above 60 degrees

**IMAGING:** Imaging should include assessment of the intimal-media thickness (IMT) of the CCA as an early mark for early changes of atherosclerosis.

**Transverse images** of the carotid vessels in grayscale should include the following;

- 1 image of the CCA at each of the following levels proximal, and distal
- 1 image of the carotid bulb
- 1 image of the carotid bifurcation

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**Longitudinal images** of the carotid vessels in grayscale should include the following:

- 1 image of the CCA proximal
- 1 image of the CCA distal
- 1 image of the carotid bulb
- 1 image of the internal carotid artery
- 1 image of the external carotid artery

Color Doppler may be recorded to demonstrate filling of normal lumen or area of flow disturbances. Include a color Doppler image if vessel is occluded. Spectral Doppler images should be performed of the proximal CCA, mid CCA, distal CCA – 2 to 3 cm below the bifurcation and the CCA bulb. Also, the proximal, mid, distal ICA and proximal, distal ECA and vertebral artery near origin.

Record maximum systolic velocity at each location. If stenosis is suspected, include maximum velocity as well as images distal to the site of the stenosis.

Images of the carotid diameter and area stenosis should be made in the transverse plane. Area stenosis most accurately below 50% stenosis – above 50% stenosis is spectral waveform analysis is the most accurate method of quantification. The cephalocaudal extent and length of plaques should be noted and documented.

Documentation is the same for both sides. The Sonographer will fill in the work sheet, and submit to the Radiologist for interpretation.

Stents should be sampled within the stent proximal and distal to each stent and the highest velocity should be documented and recorded.

**IMAGING NOTE:** Note velocities obtained in the corresponding locations of the carotid data sheet. Make note of areas of stenosis, hard and soft plaque or other vessel abnormalities. Comment on direction of flow within the vertebral artery.

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## UPPER EXTREMITY VENOUS DOPPLER PROTOCOL

**DOCUMENT REVISION DATE:**

October 3 2011

**INDICATION:** Evaluation of possible venous thrombosis, follow up known deep venous thrombosis, extremity swelling and skin erythema.

**PREP:** None.

**HISTORY NOTE:** The history note should include symptoms indicating why the exam was performed; such as extremity is swelling, skin erythema, prior history of DVT, if the patient is on blood thinning medications, prior pertinent surgeries or any occurrence of trauma.

**REVIEW:** Any prior studies pertaining to the vascular system.

**IMAGING:** Patient should be in the supine position with arm abducted, extended and palm up.

**PROTOCOL:** Begin scanning at the IJV in the sagittal position. Establish the directionality of flow. Document sagittal images of the IJV. Sagittal evaluation with Doppler imaging of the innominate, subclavian and axillary veins should be obtained with demonstration and direction of flow represented.

Return to the subclavian vein to begin compression imaging in the transverse plane. The entire vessel must be evaluated obtaining images at the following levels:

- Paired images (with and without compression)
- Subclavian vein
- Axillary vein
- Brachial vein (demonstrated at least at 3 levels, proximal, mid and distal)
- Cephalic vein (1 or 2 images at different levels where possible)
- Basilic vein (1 or 2 images at different levels where possible)
- Focal symptomatic areas if present.

End at the antecubital fossa, unless patient's symptoms warrant further evaluation of the forearm vessels.

Scan axillary, brachial (basilic and cephalic veins when possible) with sagittal imaging using color and Doppler to demonstrate vessel augmentation. Evaluate spontaneous venous flow; cardiac and respiratory phasicity of flow and possible venous filling defects.

Images with Doppler evaluation and augmentation in the sagittal plane should be obtained at the:  
Axillary vein

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Brachial vein (3 levels, proximal, mid and distal)  
 Cephalic and Basilic (when possible, one image of each)

**IMAGING NOTE:** Note is to include vessel compressibility, absence or presence of thrombosis or venous filling defects, extent of thrombosis, presence of wall irregularity or thickening, adjacent incidental pathology seen – i.e., abscess, fluid collections, superficial thrombosis

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## LOWER EXTREMITY VENOUS DOPPLER PROTOCOL

**DATE OF EDIT:** May 18, 2022

**INDICATION:** This study should be performed to evaluate for venous thrombosis and/or occlusion. If the study is for venous insufficiency or valvular incompetence a venous insufficiency study should be ordered instead of venous Doppler.

**PREP:** None.

**HISTORY NOTE:** Note location and duration of patient's pain. Note swelling, skin erythema and/or pitting edema. Also note if patient has had prior history of blood clots and if they are on blood thinning medications.

**REVIEW:** The technologist should review any prior studies pertaining to the venous system, i.e., prior Doppler ultrasound or venograms.

**IMAGING:** A 5-12 MHz linear array transducer is suitable for most patients. Place the patient in the supine position with the leg abducted and externally rotated.

**PROTOCOL:** Begin scanning in transverse in the groin. Identify the CFA and CFV and move caudally using probe pressure to test compressibility. Femoral vein followed to its distal point (passage through the adductor canal). The popliteal vein is examined with the knee slightly flexed and rotated, or with the patient on their side.

Paired images of the following (one with compression and one without):

- CFV
- The junction of the CFV with greater saphenous vein
- SFV (proximal, mid and distal femoral vein) labeled FV not SFV
- Pop Vein/TWO images (proximal and distal)
  - **One (1) transverse view of the calf veins just distal to the distal portion of the popliteal vein with and without compression, and one (1) color image of this same area, these views should be labeled calf veins. As always, if the patient complains of pain in or injury to a specific portion of the calf, include images of this region labeled as to location (posterior, lateral, etc...)**
- Evaluate the greater saphenous at three levels, proximal, distal and medial (it is not necessary to image unless there is pathology)
- Respiratory and augmentation maneuvers with spectral Doppler should be performed at the CFV. Augmentation maneuvers with spectral Doppler should be performed at the proximal, mid, distal femoral and popliteal vein

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- Evaluate and image each of the following with Doppler or color Doppler:
  - CFV
  - Junction of the CFV w/GSV
  - Proximal profunda
  - Proximal, mid and distal femoral vein
  - Proximal and distal popliteal vein
  - Posterior tibial veins at ankle

If patient presents with a specific area of pain and/or lump in the calf, document that area. If the patient complains of diffuse calf pain, evaluate the vessels that can be visualized and document appropriately. If on-site radiologist requests full evaluation of lower extremity, do as the radiologist requests. It is necessary to investigate alternative or concomitant abnormalities e.g., Baker's Cyst. The inclusion of added superficial veins into the procedure should be determined by clinical evidence.

**IMAGING NOTE:** Comment on vessel compressibility. Note location and extent of thrombosis. Comment on any incidental pathology seen, i.e., Baker's cyst, superficial thrombosis.

## **DOPPLER SURVEILLANCE OF LE BYPASS GRAFTS PROTOCOL**

### **DOCUMENT REVISION DATE:**

October 2023

**INDICATION:** For evaluation of bypass grafts, to establish patency of the grafted vessel, to evaluate for suspected vascular abnormalities such as masses, aneurysms or pseudoaneurysms.

**PREP:** None.

**HISTORY NOTE:** Include operative reports from prior vascular procedures such as bypass surgery or angioplasty. Note previous ultrasound evaluation of the graft.

**REVIEW:** Any prior procedures to include surgery, prior imaging studies, vascular studies (invasive and noninvasive).

### **IMAGING:**

#### **Doppler imaging and Velocity (cm/sec) measurements to be obtained at:**

1. Native artery proximal to graft
2. Graft just distal to anastomosis
3. Every 10 cm along graft
4. Distal graft just proximal to outflow anastomosis
5. Native artery just distal to outflow anastomosis.
6. Evaluate post and anterior tibial for patency

#### **Studies will be done:**

1. 3-4 weeks post bypass
2. 6 months post bypass
3. Then every 12 months thereafter (yearly)

#### **Threshold criteria:**

1. Normal velocities:
  - a.  $45 \text{ cm/sec} < \text{normal} < 180 \text{ cm/sec}$
2. Abnormal velocities:
  - a.  $> 180 \text{ cm/sec}$  – 50% risk of progression to graft failure. Surveillance should be increased to every 3 months X 4 then back to every 6 months if velocity remains stable
  - b.  $> 300 \text{ cm/sec}$  – Immediate intervention with Angio possible PTA
  - c. velocity ratio  $> 3.5$  – Immediate intervention with Angio possible PTA
  - d.  $< 45 \text{ cm/sec}$  – Immediate intervention with Angio possible PTA
  - e. Decrease in ABI  $> .15$  from previous exam – immediate intervention with

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Angio possible PTA

**IMAGING NOTE:** Documentation should be made with regards to vessel patency. Any vessel pathology should be noted such as plaque, areas of increased velocity, and vessel wall irregularities. Incidental pathology should be documented such as hematomas, fluid collections, masses. Interventional Radiologists are to dictate these exams.

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**VENOUS INSUFFICIENCY**

**DOCUMENT REVISION DATE:**

August 8, 2023

**INDICATIONS:** Exam is used to evaluate venous insufficiency and valvular incompetence. Patient's often have venous varicosities of the lower extremities.

**PREP:** No prep required

**HISTORY:** Obtain history pertaining to prior vascular procedures or surgeries. Report patient's symptoms.

**REVIEW:** Review any prior pertinent procedures or exams done.

**IMAGING:** Begin the exam with the patient in the supine position. Evaluate both extremities to rule out deep venous thrombosis. Take images of the following with and without compression in the transverse plane:

- CFV
- Mid Femoral vein
- Popliteal vein

With the patient supine, take longitudinal pulsed Doppler images just distal to the CFV/GSV junction within the greater saphenous vein, as the patient performs a Valsalva maneuver. Have the patient stand up to perform the remainder of the exam. Use the patient stand located in the x-ray storage room for the patient to stand on. Have the patient externally rotate the lower extremity that will be evaluated first. The extremity being evaluated should be non-weight bearing. Begin the study at the junction of the greater saphenous vein. In the transverse plane, measure the vessel size at each of the locations below. At each location in the longitudinal plane perform an augmentation maneuver using pulsed Doppler to confirm the direction and velocity of flow.

- Greater saphenous junction
- Proximal greater saphenous vein
- Mid greater saphenous vein
- Distal greater saphenous vein
- Lesser saphenous junction
- Mid lesser saphenous vein

\*\*\* If the patient is unable to stand, please elevate the head of the bed (reverse Trendelenburg) 10 to 20 degrees to simulate a standing position \*\*\* When this method is performed make sure to note it on the worksheet.

If large varicosities are visualized, it is important to demonstrate where these vessels are

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originating from off the greater saphenous vessel.

Proper augmentation of the vessel is essential to the radiologist to diagnose reflux in the vessel. This is a two-person function, coordinate assistance with the site manager.

**IMAGING NOTE:** Complete the appropriate worksheet and scan into PACS as an image. Make sure to notate any variance from the routine supine/standing protocol. These will be assigned to an IR automatically through Clario.

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## EXERCISE NON-INVASIVE VASCULAR STUDY PROTOCOL

### DOCUMENT REVISION DATE:

October 2023

**INDICATION:** Exam is done to evaluate peripheral vascular disease, lower extremity pain, pain with exercise, claudication, lower extremity ulcerations, or follow up to interventional procedure.

**PREP:** None.

**HISTORY NOTE:** Fill out the appropriate worksheet on the history page of the equipment.

**REVIEW:** Any prior studies or procedures performed.

### IMAGING:

1. Perform resting study first. Have the patient lie supine and place cuffs at the appropriate locations. One cuff should be placed on each arm unless the patient has had a mastectomy. If the patient has had a mastectomy or has had a graft in the upper extremity DO NOT use the extremity affected. If the resting study is positive (.7 or lower) there is no need to exercise the patient. Do great toe pressures on all patients; perform pressures on all toes if requested by ordering physician.
2. Standard fixed treadmill exercise test
  - a. Walk patient at 2 miles/per hour on 12% or 12-degree inclination for 5 minutes or until leg symptoms begin that prohibit continuous exercise.
  - b. Then place patient supine on the table and do stress portion of exam (brachial and ankle pressures) at 1 minute, 5 minutes and 10 minutes (found in the stress menu on the computer). If pressures are within normal range at 1 minute, exam may be terminated.
3. If the patient cannot walk, only do resting study.
4. If the patient complains of difficulty breathing, chest pain or pressure, weakness, or dizziness, terminate the exam (our goal is NOT to push the patients so hard that they would develop any of these symptoms). If the patient cannot do the exercise portion of the study it is necessary for you to give the reason why in the comments section of your report.

**IMAGING NOTE:** If the patient is unable to perform the stress portion of the exam, document the

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reason why this could not be obtained.

**REMEMBER TO NEVER COMPRESS A BYPASS GRAFT OR STENT WITH THE CUFFS DURING AN ARTERIAL PROCEDURE, DO ONLY AREAS WHERE NO GRAFT/STENT IS PRESENT. IF PATIENT HAS UNDERGONE A SILVER HAWK ATHERECTOMY PROCEDURE, DO NOT COMPRESS UPPER/LOWER THIGH AT 2 WEEK F/U EXAM.**

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**UPPER AND LOWER EXTREMITY ARTERIAL PROTOCOL  
WITH SEGMENTAL AND DUPLEX IMAGING**

**DOCUMENT REVISION DATE:**

October 2023

**INDICATION:** Exam is done when there is a history of upper/lower extremity numbness, swelling, tingling, PAD, pain, ulcerations and F/U to interventional procedures.

**PREP:** None.

**HISTORY NOTE:** Include symptoms of why the exam is being performed as mentioned in indications, prior pertinent surgeries or any trauma.

**REVIEW:** Any prior studies or procedures performed.

**IMAGING:**

- I. Perform Segmental Arterial exam upper and lower extremities. Perform duplex/color flow imaging portion of exam as follows:
  - a. For the upper extremity: Carotid artery, subclavian, axillary, brachial (prox, mid, distal), radial and ulnar arteries should be imaged. Views should include 2D, color flow, and then a velocity measurement of each segment.
  - b. For the lower extremity: Common femoral artery, profunda, superficial femoral artery (prox, mid, distal), popliteal artery, posterior tibial artery, anterior tibial artery, and dorsalis pedis artery should be imaged. Views should include 2D, color flow and a velocity measurement of each segment.

**IMAGING NOTE:** Document vessel patency as well as any areas of increased velocity, plaque, or wall irregularities. Note any incidental pathology such as fluid collections, hematomas, etc.

**REMEMBER TO NEVER COMPRESS A BYPASS GRAFT OR STENT WITH THE CUFFS DURING AN ARTERIAL PROCEDURE.**

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## NEONATAL CRANIAL ULTRASOUND – SONOGRAPHER PROTOCOL

### Scope

Standardized acquisition for neonatal/infant cranial ultrasound using fontanelle windows; designed for routine screening (e.g., prematurity, increasing head circumference) and follow-up studies.

### Indications (examples)

- Prematurity/very low birth weight; day-1 and day-7 screening common.
- Increased head circumference or persistent large fontanelle.
- Suspected craniosynostosis, trauma, hypoxic injury.
- Suspected infection or intracranial mass.
- Failure to thrive, follow-up of known pathology.

### Key Limitations

- Very small/closed anterior fontanelle limits or prevents visualization.
- Peripheral extremes of cerebrum are partially obscured even with large fontanelle.

### Equipment & Presets

- **Primary probe:** Small-footprint, wide-sector, mid-frequency vector ( $\approx$ 5–8 MHz).
- **Alternates:**
  - High-frequency linear for superficial structures (e.g., subarachnoid space, superior sagittal sinus).
  - Curvilinear ( $\sim$ 5 MHz) for axial **trans-temporal** views (evaluate opposite subdural region).
  - Endocavitary/TV probe permissible if ergonomically feasible.
- **Doppler:** Power/Color to assess venous and arterial flow as clinically indicated.

### Patient/Environment

- Warm room and **warm gel**.
- Maintain infant's oxygen environment (humidicrib/incubator) when applicable.
- Support and gently immobilize head with soft cloths/rolls; avoid excessive transducer pressure (especially in preterms).

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## Windows & Orientation

- **Primary window:** Anterior fontanelle (AF).
- **Adjunct windows:** Posterior fontanelle as needed; **trans-temporal** (axial) through temple with curvilinear; linear array over AF for superficial venous/subarachnoid assessment.

## Standard Acquisition Sequence

### A. Coronal Series (AF)

Acquire stills and/or short cine loops as you **sweep anterior → posterior**:

1. **Frontal** lobes (orbit roofs, anterior horns).
2. **Caudate region** (foramen of Monro/caudate nucleus).
3. **Sequential slices** from caudate region to **trigones** of the lateral ventricles (include Sylvian fissures/3rd ventricle level and brainstem level).
4. **Occipital** region (far posterior coronal).

### B. Sagittal Series (AF)

Rotate 90° from coronal:

1. **Midline:** corpus callosum, cavum septi pellucidi, **3rd/4th ventricles**, cerebellum/vermis.
2. **Parasagittal** (left & right): include **caudothalamic notch** and lateral ventricles.
3. **Far-lateral** (left & right): periventricular white matter.

### C. Linear-Array Sweep (AF)

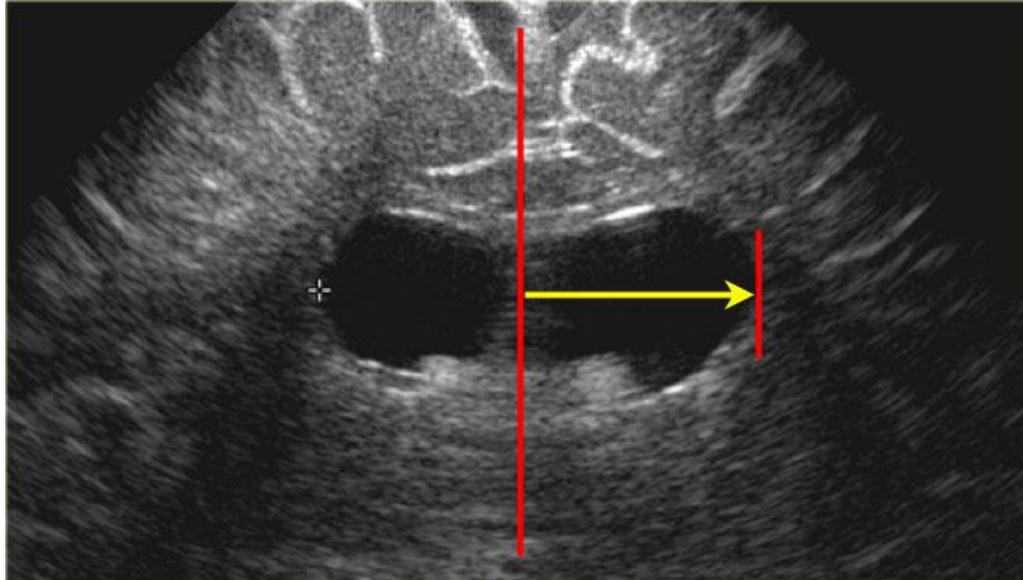
- Transverse sweep to assess **superior sagittal sinus** patency and **subarachnoid space**; depth typically to 3rd ventricle.

### D. Trans-temporal Axial (curvilinear)

- Axial plane through temple(s) with attention to **contralateral subdural** region.

## Required Measurements

- **Levine index:**
  - The Levine index is the absolute distance between the falx and the lateral wall of the anterior horn in the coronal plane at the level of the third ventricle. This is performed for the left and right side.



## Documentation & Labeling

- Label side (L/R), plane (C = coronal; S = sagittal; AX = axial), level (e.g., **C-anterior, C-caudate, C-trigone, C-occipital; S-midline; S-para-L/R; S-far-lat-L/R; AX-temporal**).
- **Pathology:** Document in **two orthogonal planes**, include **measurements**; consider Doppler of vascular channels (e.g., superior sagittal sinus) when relevant.
- Save cine clips of sweeps when available.

## Minimum Image Set (Checklist)

### Coronal (AF)

- Anterior/frontal.
- Caudate/foramen of Monro.
- Mid-anterior (Sylvian fissures/3rd ventricle).

- Mid-coronal (brainstem level).
- Trigones (zoom as needed to show choroid plexus).
- Far posterior/occipital.

## Sagittal (AF)

- Midline (CC, CSP, 3rd/4th ventricles, cerebellum).
- Parasagittal left (caudothalamic notch, lateral ventricle).
- Parasagittal right (caudothalamic notch, lateral ventricle).
- Far-lateral left (periventricular white matter).
- Far-lateral right (periventricular white matter).

## Adjunct

- Linear-array transverse over AF (SSS patency, subarachnoid space).
- Axial **trans-temporal** (temple) ± bilateral.

## Quality & Safety Notes

- Use generous gel; **minimize probe pressure**.
- Keep infant calm/warm; maintain lines and respiratory support as placed.
- If AF window inadequate, document limitation and attempt posterior fontanelle or trans-temporal alternatives.
- ALARA: Use the lowest output and shortest dwell that achieves diagnostic quality; optimize settings before increasing power and monitor TI/MI continuously. Keep Doppler brief and targeted.

## Common Pitfalls

- Mislabeling left/right or plane.
- Incomplete sweeps (missed posterior coronal or far-lateral sagittal).
- Measurements not performed at specified anatomical levels.
- Failure to document pathology in two planes with measurements.

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**Tech Comments**

Note any study limitations (window, motion, oxygen environment constraints).

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## INTUSSUSCEPTION ABDOMEN LIMITED ULTRASOUND

### Patient Prep:

1. None.

### Survey:

Perform a real-time survey of the neonatal bowel looking for a mass, fluid collection or any other abnormality.

Use Doppler or color flow to distinguish vessels and abnormalities.

### Image Documentation:

Each image must be labeled with the patient's full name, medical record number, accession number, initial of the imaging technologist, organ/area identification, scanning plane and patient orientation if different from supine.

If an image of a structure is not well seen, take an image of the structure and annotate the purpose of the image.

### General Procedure description:

1. Evaluate the bowel in the abdomen for a mass, fluid collection or any abnormality.

### Guidelines for abdomen ultrasound:

#### **ABDOMEN**

1. Evaluate RUQ, RLQ, LUQ, LLQ, midline abdomen and pelvis for a mass or fluid collection. Provide images in longitudinal and transverse plane to verify this area was evaluated for an abnormality.
2. If an abnormality which might be an intussusception is discovered please take in addition to static images also take cine clips in its LONG and SHORT axis.

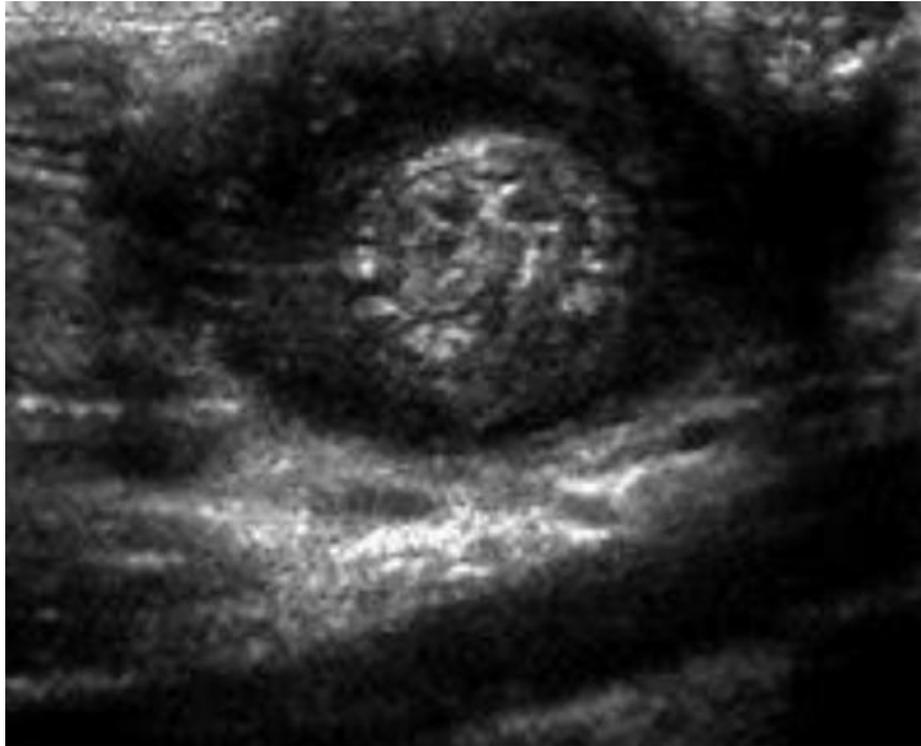
#### **MASS OR FLUID COLLECTION NOTED**

1. Make sure all images are labeled exactly where the mass or fluid collection is located.
2. Image in longitudinal plane with and without measurement.
3. Image in transverse plane with and without measurement.
4. Images in longitudinal plane to cover entire mass or fluid collection.
5. Images in transverse plane to cover entire mass or fluid collection.
6. Provide images with and without graded compression of the area.
7. At a minimum, at least one longitudinal and one transverse cine clips of the mass or fluid collection.
8. At a minimum, at least one color Doppler flow image in longitude and transverse.

## INTUSSUSCEPTION

1. Intussusception occurs when bowel prolapses into more distal bowel.
2. Most are in the ileocolic region.
3. Some symptoms patients may present with are colicky abdomen pain, vomiting and bloody stool.
4. A palpable abdominal mass may be noted.
5. In longitudinal, the mass will appear with an echogenic center with hypoechoic layers on each side.
6. In longitudinal, intussusception can have the appearance of a pseudokidney or sandwich sign.
7. In transverse, the mass will appear as alternating hypoechoic and hyperechoic rings (target sign)
8. Intussusception usually occurs in children ages 6 months to 2 years. With a higher incidence (2:1) in males.





**PEDIATRIC HIP ULTRASOUND PROTOCOL**

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**Purpose:** To evaluate the infant hip for developmental dysplasia and/or subluxation.

**Transducer:** L9-3, or L12-5

All transducers are to be cleaned after each patient.

A germicidal wipe is to be used after any infectious exposure.

**Preparation:** No patient prep necessary

**Technique and Patient Position:** Patient is in the supine or lateral position with the affected knee flexed.

**Objectives:**

- Obtain patient history (gender, breech birth, family history, maternal oligohydramnios, etc.)
- Obtain any prior studies to use as comparison.
- Evaluate the infant hip for dysplasia.
- Evaluate for subluxation or dislocation of the femoral head utilizing non-stress techniques.

**Procedure:**

1. In the coronal plane, ensuring that the ilium is horizontal across the screen and there is visualization of the triradiate cartilage and the ischium.
2. Obtain coronal images of the hip joint without stress in a neutral (15-20\* flexion) or flexed position to include the following with appropriate annotation on the screen:
  - Demonstrate the femoral head within the acetabulum.
  - Establish the base line: along the ilium, through the femoral head.
  - Establish the roof line: parallel to the acetabular roof intersecting the baseline
  - Establish the line of inclination: across the top of the femoral head, through the labrum and intersecting the 1st two lines.
  - Document the  $\alpha$  and  $\beta$  angles ( $\alpha > 60^\circ$  and  $\beta < 55^\circ$  is considered normal by Graf's Classification).
  - Measure the circumference of the femoral head (>50%).
3. In the transverse plane with the hip flexed at 90\*, obtain images of the femoral head within the acetabulum and include appropriate annotation on the screen.

**NOTE:**

The American Academy of Pediatrics official stance is to wait until six weeks (adjusting for prematurity) in almost all cases (with the exception of an Ortolani-positive test which should prompt an Ortho consult). When an imaging study is indicated, whether by risk factors or by suspicious physical examination, it is best to defer diagnostic hip ultrasound until age 6 weeks (adjust for prematurity) or plain anteroposterior pelvis radiograph at ages 4-6 months. Ultrasonography may be done earlier in guiding *treatment* of an Ortolani-positive hip. Initial diagnostic ultrasound usually is deferred until after age 6 weeks because of the high rate of false positives or immature hips, which spontaneously resolve most often by age 6 weeks. Six weeks is a very good cutoff with only rare exceptions when the test is ordered specifically by pediatric orthopedists claiming that it could alter treatment.

**Required Images;**

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Longitudinal/Coronal images to include:

- Femoral head within the acetabulum.
- Establish the base line, roof line and line of inclination
- Measure the  $\alpha$  and  $\beta$  angles
- Measure the circumference of the femoral head
- Image of femoral head within acetabulum

## SCREENING BREAST ULTRASOUND PROTOCOL

\*Scan and assess the entire right breast including axillary tail prior to taking any images.

If negative,

- UOQ                                   SAG & TRANS
- UIQ                                   SAG & TRANS
- LIQ                                   SAG & TRANS
- LOQ                                   SAG & TRANS
- SUBAREOLAR                       SAG & TRANS
- AXILLARY TAIL                     SAG & TRANS

If positive,

- UOQ                                   SAG & TRANS
- UIQ                                   SAG & TRANS
- LIQ                                   SAG & TRANS
- LOQ                                   SAG & TRANS
- SUBAREOLAR                       SAG & TRANS
- AXILLARY TAIL                     SAG & TRANS
- Document all findings at the end in a clockwise manner, if possible

Example:

- 12 O’CLOCK, 4 CM FROM NIP
- 3 O’CLOCK, 1 CM FROM NIP
- 7 O’CLOCK, 9 CM FROM NIP

\*Each finding must include:

- Split screen SAG and TRANS w/ and w/o measurements
- Color SAG and TRANS
- Cine clip SAG and TRANS (optional and helpful for any subtle or ill-defined findings)
- Solid mass findings must include axilla to assess for lymphadenopathy. If lymph nodes appear within normal limits, document only one lymph node (w/ & w/o measurements, including cortex and color).

\*Repeat for left breast

### TIPS:

#### EXAM PREP/HISTORY

- Check order (physician may want a specific location examined).
- Anyone age 30 and up must have a mammogram first.
- Check for priors and start from the most recent screening mammogram.
- Be sure to look at all images (mammogram, ultrasound, and MRI), review reports and recommendations.
- If patient is here for a 6 month follow up, write down prior measurements of the specified lesion/s to be followed on previous recommendation.
- When following a lesion, take note of the prior measurement, depth, shape, and echogenicity of the lesion.
- Also take note of the frequency and depth that used on the prior ultrasound.
- When showing a case to a radiologist, be sure to know how long we have been following this area for?
  - Is it the 1st, 2nd, 3rd or 4th 6 month follow up?

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**PATIENT PREP**

- Positioning is key. Make sure the patient is rolled up using a wedge and arm up over their head. The breast must be lying flat and centered.
- Use a ruler to make sure the distance from the nipple is as accurate as possible. This will be helpful for future follow up or potential biopsy.
  - Lesions that require follow-ups are typically followed for up to 2 years

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## DIAGNOSTIC BREAST US

**Indications:** Include, but are not limited to:

1. Evaluation and characterization of palpable masses and other breast related signs and/or symptoms
2. Evaluation of suspected or apparent abnormalities detected on other imaging studies, such as mammography or magnetic resonance imaging.
3. Initial imaging evaluation of palpable masses in women under 30 years of age who are not at high risk for development of breast cancer, and in lactating and pregnant women.
4. Evaluation of problems associated with breast implants.
5. Evaluation of breasts with micro calcifications and/or architectural distortion suspicious for malignancy or highly suggestive of malignancy in a setting of dense fibro glandular tissue, for detecting an underlying mass that may be obscured on the mammogram.
6. Guidance of breast biopsy and other interventional procedures.
7. Treatment planning for radiation therapy.
8. Identification and biopsy guidance of abnormal axillary lymph node(s).

**Scheduling:** 30 minutes

**Patient Preparation:** None **Patient Position:** Supine with ipsilateral arm placed above the patients head. The patient should be positioned with a wedge below the ipsilateral shoulder as needed to minimize the thickness of the breast tissue being penetrated.

**Equipment:** Highest frequency possible without compromising resolution and penetration to the level of the chest wall muscle. Usually 12MHz or higher. In some cases, it may be necessary to use a 10MHz probe to evaluate a very deep lesion in a large breast. In this circumstance, at least one image should be taken documenting attempted use of the higher frequency probe. Additional images using virtual convex, logiq view, or a curved probe may be necessary to accurately measure very large lesions. In cases of very superficial lesions, a stand-off pad may be necessary.

**All recorded images should be labeled with the following:**

- Right or Left Breast

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- Location of the lesion- use clock face notation and distance from the nipple. Measurements should NOT be made from the edge of the areola, as areolar size can vary. In some cases, body marker diagrams may be used in place of clock face notation. Images annotated with only quadrant location (e.g. upper/outer, lower/inner, etc) are not acceptable.
- Transducer orientation- sagittal and transverse should be used. It may be helpful in some circumstances to also include radial, anti-radial, or oblique images, but these should not replace sagittal and transverse images.
  - Example: Right Breast, 3 o'clock, 5cm from nipple, trans

**Protocol for documenting breast masses:**

It is necessary for the technologist performing an initial ultrasound of a breast to label masses appropriately for follow up purposes. Masses should be labeled with appropriate location and must be numbered. Masses should be numbered according to the breast they are found within, ie: R1 (first mass within RIGHT breast), R2, L1 (first mass within LEFT breast) etc. Images should also be labeled with “Area of Palp, pain, swelling, scar etc”

Technologists performing follow up exams should document masses using the same labeling criteria as previous sonographer.

If a mass is not visualized that was seen on a prior ultrasound, document the area the mass was previously seen within and continue numbering subsequent masses as they were previously documented.

- 1.) Image capture of mass in sagittal plane with measurement.
- 2.) Image capture of mass in sagittal plane without measurement.
- 3.) Image capture of the same mass in transverse plane with measurement.
- 4.) Image capture of mass in transverse plane without measurement.
- 5.) If additional images of any given masses are felt to be helpful (e.g. color/Doppler, clips, oblique or off-center, harmonics etc), these images should be taken subsequent to the initial sagittal and transverse images of that same mass, and before imaging additional masses.
- 6.) Subsequent masses captured and measured in same format (sagittal followed by transverse)

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7.) Axilla of same breast should be imaged to evaluate for abnormal lymph nodes or mass

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**Guideline for what images should be included on “NORMAL” studies**

With the advent of PACS there has been an increase in the number of images in “NORMAL” exams. This may be related to not having to film the study and the mistaken belief that storing images on PACS is “free”.

The following is a guideline on what images should be included on “NORMAL” studies, in an effort to decrease the number of images while adhering to the ACR standards:

**LIVER (6-8 views)**

- Liver parenchyma
- Major vessels in region (aorta, IVC)
- Liagmentum teres
- Right diaphragm and pleural space
- Right and left hepatic veins
- Right and left branches of porta vein

**THYROID (17 images)**

- 3 sagittal, right and left, one each side with color
- 3 transverse, sup, mid, inf, one each side with color
- Isthmus transverse
- 1 sagital with maximum length and depth measurements
- 1 transverse with maximum width and depth, right and left

**FEMALE PELVIS (12-24 images)**

- Longitudinal UTX with length and AP measurement
- Endometrial thickness
- Myometrium
- Cervix/vagina in transverse
- Transverse UTX
  - Lower uterine seg
  - Mid
  - Fundal
  - Maximum transverse measurements
- Adnexa

**\*\* REPEAT ABOVE FOR ENDOVAGINAL EXAM**

- long measure
- transverse measure
- color

**RENAL (16 images)**

- 4 longitudinal views kidney, right and left
  - at least one including liver/spleen

- at least one including largest measurement
- 3 transverse view, right and left
  - superior
  - mid
  - inferior
- 2 bladder views
  - longitudinal
  - transverse

#### BILIARY TRACT (2-3 images)

- Need relationship between bile ducts, hepatic artery and portal vein
- Measure CHD

#### GALLBLADDER ONLY (10 images)

- 3 longitudinal
- 3 transverse
- CHD proximally and at head of pancreas
- Liver to document no intrahepatic dilatation

#### TESTICULAR (19-21 images)

- 3 sagittal, right and left
- 3 transverse, sup, mid, inf
- Epididymis, right and left
- Venous and arterial Doppler
- Side-by-side comparison
- Valsalva if varicocele suspect

#### OBSTETRICAL EARLY/FIRST TRIMESTER (19-20 images)

- Uterus, 3 transverse and 3 sagittal
- Gestational sac in 3 planes
- CRL measurement x 3
- M mode cardiac
- Adnexa in 2 planes
- Cul-de-sac
- Yolk sac

#### UPPER EXTREMITY DOPPLER ULTRASOUND

- Jugular with flow and Doppler
- Subclavian with flow and Doppler
- Axillary, split screen with and without comp.
  - color
  - augment
- Basilic, split screen with and without comp



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- color
- Cephalic, split screen with and without compress
  - color
- Brachial, split screen with and without compress
  - proximal
  - distal
  - color
  - aug mid
- Anticubital, split screen with and without color