RENAL ULTRASOUND EXAMINATION

POLICY: Renal/urinary tract ultrasound will be performed with an order from a physician or other qualified clinical practitioner. The examination will be supervised and interpreted by a radiologist or other licensed practitioner who is qualified by reason of training to understand the normal anatomy, pathophysiology of the urinary tract, and integration of ultrasound with other imaging techniques to optimize the probability of detecting disease.

PURPOSE: To assess the anatomy of the urinary tract and document normal and abnormal structures therein.

INDICATIONS: Ultrasound of the urinary tract is indicated for patients with signs, symptoms, and/or laboratory evidence of urinary system disease. Patients who, for historical reasons, are at risk for urinary tract disease, even without signs, symptoms, or laboratory evidence, are also candidates for ultrasound examination.

PATIENT PREPARATION: Whenever possible, patients should be fasting for a minimum of six hours prior to ultrasound examination of the urinary tract. One hour prior to the examination, patients should void completely and, unless fluid restricted, drink 20 ounces of noncarbonated fluid and refrain from voiding until instructed to do so.

PROCEDURE: Each organ should be imaged in its entirety (e.g. long and transverse views) before imaging the next organ. The order of organ imaging will be (minimal number of images in parenthesis):

- Bladder (6 images)
- Right kidney (7 images, 1 cine)
- Left kidney (7 images, 1 cine)

URINARY BLADDER:

- Whenever possible, the ultrasound examination should begin with the urinary bladder full.
- The urinary bladder should be examined to image its entire luminal surface, bladder outlet, wall thickness, and expected positions of the distal ureters.
- Documentation of ureteral jets is not required in all cases. However, an attempt should be made to document ureteral jets using color Doppler when there is suspected ureteral obstruction. Evidence of obstruction may include: new hydronephrosis or hydroureter (including flank pain in pregnancy), a sonographically visible ureteral calculus, follow up to a ureteral calculus seen on a recent CT or acute flank pain.
- With the urinary bladder full, minimal stored images should include:
  - one right parasagittal view of the bladder labeled long bladder rt.
  - one midline sagittal view of the bladder labeled long bladder ml.
  - one left parasagittal view of the bladder labeled long bladder lt.
• one transverse view through the bladder base at the expected ureterovesicle junction, labeled *trans bladder base*.
• one transverse view through the middle third of the bladder labeled *trans bladder mid*.
• one transverse view through the upper third of the bladder labeled *trans bladder sup*.

In obtaining a pre-void bladder volume and post-void residual, these additional images are required (the volume calculation package on the ultrasound system should be used if available):
• one pre-void midline sagittal view with maximal cephalocaudal luminal diameter measured with electronic calipers and labeled as *long bladder pre-void*.
• one pre-void transverse view through the largest transverse diameter of the urinary bladder with the maximal transverse luminal diameter measured with electronic calipers and labeled *trans bladder pre-void*.
• one post-void midline sagittal view with maximal cephalocaudal luminal diameter measured with electronic calipers and labeled as *long bladder post-void*.
• one post-void transverse view through the largest transverse diameter of the urinary bladder with the maximal transverse luminal diameter measured with electronic calipers and labeled *trans bladder post-void*.

Note: patients should be asked to void as completely as possible, requesting them to repeat voiding (double void) if retained urine is demonstrated after voiding.

**KIDNEYS:**
• Examination of the kidneys should be performed to visualize the entire capsule through the longest axis and perpendicular to the long axis. Observations should include the renal size, contour, intrinsic echogenicity of the kidneys, condition of the collecting structures, echogenicity of the kidneys relative to the liver and spleen, and perinephric spaces.
• The kidneys can be examined from whatever position (sagittal, coronal, prone, decubitus, or supine) that optimizes the definition of the entire renal capsule and maximizes the measured dimensions. The kidneys may be best investigated after voiding.
• The kidneys should be surveyed completely in longitudinal and transverse planes, from lateral to medial and superior to inferior respectively.
• Minimal stored images of the kidneys should include:
  • two longitudinal views of the maximal renal length of each kidney measured with electronic calipers and labeled *long right* or *left kidney*;
  • one longitudinal view of the each kidney with sufficient volume of liver or spleen to allow comparison of the relative echogenicity of those organs to the kidneys, labeled *long right* or *left kidney*;
  • additional longitudinal views of each kidney may be necessary if the entire renal parenchyma was not well visualized in the above required images, appropriately labeled *long right* or *left kidney sup, mid* or *inf* (for example, a
separate longitudinal image demonstrating the inferior pole of a kidney may be necessary);

- one view of the upper one third of each kidney imaged perpendicular to its long axis, and labeled *trans right* or *left kidney sup*.
- one view of the middle one third of each kidney imaged perpendicular to its long axis, and labeled *trans right* or *left kidney mid*.
- one view of the middle one third of each kidney imaged perpendicular to its long axis, with the maximal anteroposterior and transverse diameters of each kidney measured with electronic calipers, and labeled *trans right* or *left kidney mid*.
- one view of the lower one third of each kidney imaged perpendicular to its long axis, and labeled *trans right* or *left kidney inf*.
- one transverse cine clip of each kidney from superior to inferior labeled *trans right* or *left kidney sup-inf*.
- sufficient images of each kidney to allow assessment of the relative echogenicity of the renal cortex, medulla (pyramids), and sinus, appropriately labeled *long* or *trans, right* or *left kidney*.

**PATHOLOGIC CONDITIONS:** When pathologic processes are detected during the course of the examination, extra images are necessary to characterize the abnormalities. An additional cine clip should be obtained, in a longitudinal plane, when there is pathology recognized. The following is a description of commonly encountered abnormalities, of conditions which should be considered during the examination, and the minimum additional stored images expected for each circumstance. The list is not intended to be comprehensive, and sonographers are expected to apply their knowledge of pathophysiology to provide clear images of the disease processes they encounter.

**Renal mass:** The examination shall attempt to differentiate solid masses, simple cysts, and complex cystic masses. For all masses up to 20mm greatest diameter, a stored image should be measured with electronic calipers in at least one view. For all masses exceeding 20mm maximal diameter, images should be stored in two orthogonal planes and measured in three dimensions with electronic calipers. If the calipers interfere with the visualization of the mass, images should be stored with and without calipers. If the mass adds to the maximal long or transverse diameters of the kidney, the maximal long and transverse renal measurements should include the mass. The position of the mass in the kidney (*lat, mid, or med*) (*sup, mid, or inf*), the orientation of the image (*long or transverse*), and the *kidney right* or *left* shall be labeled on each image.

**Obstruction:** The examination shall attempt to differentiate distended intrarenal collection structures from sinus cysts (parapelvic cysts) by demonstration of the connection of the renal pelvis, infundibula, and calyces. The degree of obstruction (hydrenephrosis) should be documented by involvement of the indundibula and calyces as well as sparing or obliteration of the sinus fat. The examination should define the extent of involvement, i.e. part of or all of the kidney, and one or both kidneys. The examination should attempt to identify fluid distended ureters and a point of transition
between a dilated ureter and a normal ureter. An attempt should be made to identify a source of obstruction in the intrarenal collecting system, ureter, or bladder outlet. In all cases of known or suspected obstruction, the ureteral jets should be documented using color Doppler. All stored images shall be labeled appropriately as to structure (kidney, or ureter, or bladder), position (right or left), and orientation (long or transverse).

**Urinary tract infection:** The examination shall attempt to identify a cause of, or contributing factor to a urinary tract infection such as obstruction of the collecting system, reflux, (nonobstructive hydronephrosis), renal stones, bladder stones, or incomplete voiding (post void residual). Complications of a urinary tract infection such as renal abscess, pyonephrosis, cortical atrophy, or focal pyelonephritis (renal mass) should be sought. Stored images shall be labeled appropriately as to structure (kidney, or ureter, or bladder), position (right or left), and orientation (long or transverse).

**Urinary tract stones:** The examination shall attempt to identify calculi in the urinary tract by demonstration of a reflective focus which creates an acoustical shadow. Several settings on the ultrasound system (GE Logiq 9 or E9) should be adjusted in order to optimally image renal calculi. The shadowing produced by renal calculi can be enhanced by scanning without crossbeam (harmonics only with a narrowed sector width) and with one focal zone at the level of the kidney. The frequency should be set to the maximum frequency possible, while still allowing enough penetration to obtain an image in the given patient. The maximal diameter of the reflector should be measured with electronic calipers in a plane perpendicular to the ultrasound beam, and at least two images, preferably in orthogonal planes, of each reflector stored to demonstrate reproducibility. The examination should differentiate calcifications within the renal parenchyma (nephrocalcinosis) from calculi in the collecting system, and obstructing from nonobstructing calculi. Stored images shall be labeled appropriately as to structure (kidney, or ureter, or bladder), position (right or left), and orientation (long or transverse).