

Ultrasound – Renal Evaluation

PURPOSE:

To evaluate the kidneys for diffuse and focal renal abnormalities including stones and masses; to evaluate the renal collecting systems for hydronephrosis; and to evaluate the urinary bladder for urinary retention, bladder wall thickening, and intraluminal findings.

SCOPE:

Applies to all ultrasound renal studies performed in Imaging Services / Radiology

INDICATIONS:

- Increased creatinine or other findings of poor renal function
- Decreased urinary output; suspected hydronephrosis
- Flank pain; hematuria; suspected renal stones
- Urinary tract infection; pyelonephritis
- Conditions associated with focal renal abnormalities (examples: polycystic disease, tuberous sclerosis, von Hippel Lindau, etc)
- Follow up known renal abnormalities

CONTRAINDICATIONS:

- No absolute contraindications

EQUIPMENT:

Curvilinear transducer with a frequency range of 1-9 MHz that allows for optimal penetration and resolution of anatomy, depending on patient's body habitus

PATIENT PREPARATION:

- Patient should be well hydrated.
- The patient should be kept from voiding 30 minutes prior to study.

EXAMINATION:

GENERAL GUIDELINES:

A complete examination includes evaluation of the entirety of both kidneys and bladder

EXAM INITIATION:

- Introduce yourself to the patient
- Verify patient identity using patient name and DOB
- Explain test
- Obtain patient history including symptoms. Enter and store data page.
- Place patient in supine, right lateral decubitus (RLD), and/or left lateral decubitus (LLD) position, optimizing the acoustic window for kidney independently.

TECHNICAL CONSIDERATIONS:

- Review any prior imaging, making note of abnormalities or other findings requiring further evaluation - follow up.
- Examine the right kidney from an anterolateral (in supine) or lateral approach in LLD position, with the liver as a sonographic window

- A posterolateral in an LLD or posterior in prone position may be required if the lower pole is not optimally seen (due to overlying bowel gas).
- Examine the left kidney from a posterolateral or direct lateral approach in the RLD position.
 - Ensure that both poles of the kidney are clearly seen. A posterior approach with the patient prone may be required if the lower pole is not completely seen (due to overlying bowel gas). An intercostal approach may be required for the upper pole.
- Assess the cortical echogenicity of the right kidney in comparison with the adjacent liver.
- Renal cortex, pelvis, and peri-renal region should all be assessed for abnormalities.
- Cine sweeps, both on transverse and long orientations, should be obtained through the entirety of each kidney.
- Color Doppler of the **renal cortex** (including upper, mid, and lower segments) allows for identification of segmental perfusion variations, particularly important for suspected pyelonephritis. **For improved cortical perfusion, micro-Doppler Techniques:**
 - **Philips - MicroFlow Imaging (MFI / MFI-D)**
 - **GE - MicroVascular Imaging (MVI)**
 - **Siemens - Slow Flow**
- Color Doppler sweep through the kidney helps identify twinkling artifact seen with calculi.
- Color Doppler at the renal pelvis helps distinguish blood vessels from dilated collecting system (i.e. hydronephrosis).
- Focal renal abnormalities should be documented without and with size measurements and with color Doppler.
 - Targeted cine sweeps are helpful in demonstrating subtle abnormalities
- **If renal stones are suspected:**
 - Optimize grayscale image to demonstrate acoustical shadowing:
 - Increase frequency range
 - Turn on Harmonics to reduce noise
 - Turn off compound imaging (eg. SonoCT)
 - Decrease speckle reduction (eg. XRes setting)
 - Decrease dynamic range (increase compression)
 - **Or can use stone presets (eg. "Renal2" or "Renal*" presets)**
 - Use and optimize color Doppler to demonstrate "twinkling" artifact
 - Increase frequency range
 - Decrease Doppler scale, but avoid aliasing of the intra-renal vessels by setting it too low.
 - Minimizing noise/artifact (decrease color gain)
 - **Measure largest stone in each kidney** - largest single dimension only
 - Other stones can be annotated with calipers or arrows (no preference).
- Evaluate distal ureters and ureterovesicular junction with Color Doppler for twinkling artifact from ureteral stones (best seen on transverse scanning) and for distal ureteral dilatation.
- Bladder lumen and wall abnormalities should be noted. Focal abnormalities should be documented without and with size measurements and with color Doppler.
- **If hydronephrosis is found:**
 - Evaluate distal ureters and ureterovesicular junction with Color Doppler for twinkling artifact from stones (best seen on transverse scanning) and for distal ureteral dilatation.
 - Within the bladder, obtain bilateral ureteral jets.

- With a full bladder, post-void imaging should be performed to document persistent hydronephrosis and/or bladder post-void residual.
- **If pyelonephritis is suspected:**
 - Doppler evaluation of the **renal cortex** (including entire upper, mid, and lower segments) for perfusion variations. **For improved cortical perfusion, use micro-Doppler techniques if available:**
 - **Philips - MicroFlow Imaging (MFI / MFI-D)**
 - **GE - MicroVascular Imaging (MVI)**
 - **Siemens - Slow Flow**

DOCUMENTATION:

- Kidneys
 - Grayscale (annotate as in *italics*)
 - Longitudinal images:
 - Far medial (cortex only) - *Med*
 - Mid segment – *Mid*
 - Without and with maximum longitudinal measurement
 - Without and with color Doppler if pelvicaliectasis is suspected
 - Far lateral (cortex only) – *Lat*
 - **(Right Kidney Only): Right Kidney – Liver comparison image**
 - CINE CLIP:
 - Lateral to Medial
 - Cine clip through any focal abnormality
 - Transverse images:
 - Upper pole (cortex only) – *Sup*
 - Mid superior – *Mid Sup*
 - Mid - *Mid*
 - Mid inferior – *Mid Inf*
 - Lower pole (cortex only) – *Inf*
 - CINE CLIP:
 - From upper pole through lower pole
 - Cine clip through any focal abnormality
 - Color Doppler
 - Images of renal pelvis without and with Color Doppler to distinguish blood vessels from hydronephrosis
 - Renal cortex (upper, mid, and lower segments) to identify segmental perfusion changes. Use lower velocity setting and optimal color gain to demonstrate flow in small cortical vessels.
 - **For improved cortical perfusion, micro-Doppler techniques (if available):**
 - **Philips - MicroFlow Imaging (MFI / MFI-D)**
 - **GE - MicroVascular Imaging (MVI)**
 - **Siemens - Slow Flow**
 - Cine sweeps

- Longitudinal and transverse of each kidney
- Bladder
 - Grayscale
 - Transverse images (annotate as in *italics*):
 - Fundus (*Sup*)
 - Mid (*Mid*)
 - Base (*Inf*)
 - CINE CLIP, superior to inferior
 - Longitudinal images (annotate as in *italics*)
 - Right lateral (*Lat Rt*)
 - Midline (*Mid*)
 - Left lateral (*Lat Lt*)
 - CINE CLIP, right to left
 - Color Doppler
 - Right and left ureteral jets (**only if hydronephrosis was identified**)
 - Right and left ureterovesicular junction for twinkling artifact from distal stones (**if nephrourolithiasis is suspected**)
 - Images without and with color Doppler of focal abnormalities
 - Bladder Volumes
 - **If hydronephrosis present, or if bladder volumes specifically requested:**
 - Measure and calculate pre-void bladder volume.
 - Have patient void. Re-measure and calculate post-void bladder volume.
 - Re-image each kidney to document persistent or resolution of hydronephrosis (if present pre-void).
 - Cine clip of debris, if present, to demonstrate mobility.
- Prostate
 - (only if appears enlarged, deforming the overlying bladder)
 - Longitudinal and transverse images with measurements in 3 orthogonal planes as specified above.
- Data page(s)

PROCESSING:

- Review examination images and data pages
- Export and review all images in PACS
- Confirm data in Imorgon (where appropriate)
- Document relevant history and any study limitations in Tech Notes

REFERENCES:

ACR-AIUM Practice Guideline (Revised 2007)

REVISION HISTORY:

STATUS	NAME & TITLE	DATE	BRIEF SUMMARY
Submission	David Fetzer, MD, Director	11/15/2015	Submitted
Approval	David Fetzer, MD, Director	11/15/2015	Approved
Review		06/19/2017	Reviewed
	Anthony Setiawan, MD	11-14-2018	Routine Review
Revisions	David Fetzer, MD	06-19-2017	Added emphasis on acquiring cine sweeps through each kidney
	David Fetzer, MD	11-21-2018	Clarified with ureteral jets are to be included; added eval of UV junction with color Doppler for distal stones
	David Fetzer, MD	12-11-2019	Adjusted Documentation section to reflect preferred order of image acquisition.
	David Fetzer, MD	01-15-2020	Updated information regarding need to obtain cortical perfusion images for suspected pyelo
	David Fetzer, MD	02-23-2020	Clarified information regarding bladder volume calculations
	David Fetzer, MD	02-23-2020	Reduced still images through kidneys; clarified direction of cine clip
	David Fetzer, MD	06-15-2022	Added requirement for right kidney-liver image. Added additional information regarding micro-Doppler techniques for renal cortical perfusion
	Skye Smola RDMS, RVT	9/20/23	Measure largest stone in each kidney, largest single dimension only; Other stones can be annotated with calipers or arrows (no preference)