RENAL TRANSPLANT & EN BLOC RENAL TRANSPLANT ULTRASOUND PROTOCOLS

URENTX – Evaluation of Renal TX with or without spectral Doppler
URENBX – Renal Transplant Biopsy without Doppler. Doneby nephrology and reported by radiologist.
URENBD – Renal Transplant Biopsy with Doppler. Done by nephrology and reported by radiologist.

****For repeat exams within 7 days, limited 2D and color Doppler examination for fluid collections or hydronephrosis is acceptable. Spectral Doppler does not need to be repeated unless indicated, or previously abnormal.**

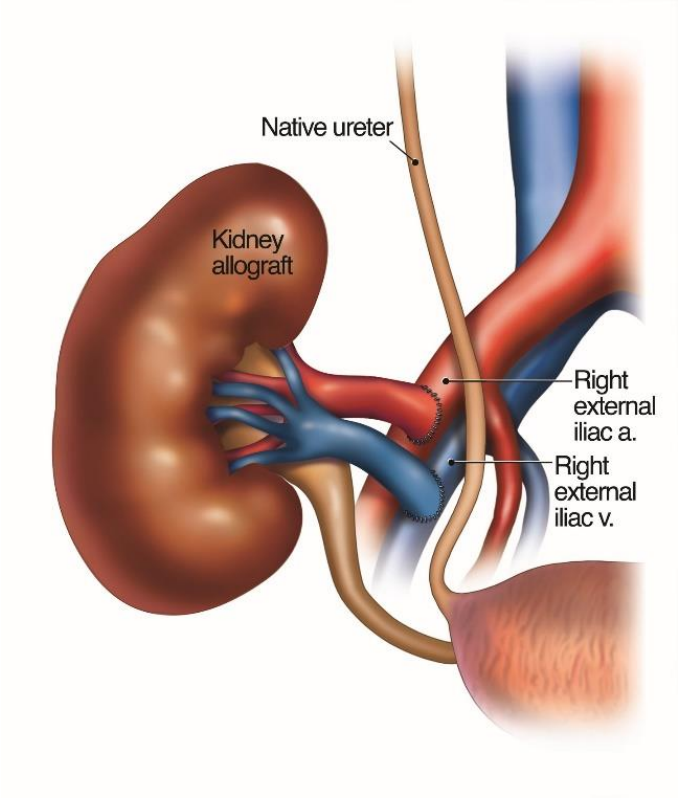
PATIENT PREP: No Prep

IMAGES TO OBTAIN

The following images should be obtained for each individually transplanted kidney requested. See below for separate EN BLOC renal transplant protocol.

KIDNEY TRANSPLANT:

- Document and label its location in pelvis. (RLQ or LLQ)
- Measure sagittal kidney length
- Sagittal images of medial, mid and lateral sections
- Transverse images of upper, mid, and lower poles
- Document presence of stent if seen.



ASSESS FOR FLUID COLLECTIONS:

- Document any fluid collections with and without color Doppler images.
- Include sagittal and transverse measurements of any collections seen.

BLADDER AND URETER:

- Sagittal and transverse 2D images. Show stent if present
- Document and measure the ureter if dilation is seen. Show stent if seen within.

COLOR DOPPLER IMAGES TO OBTAIN

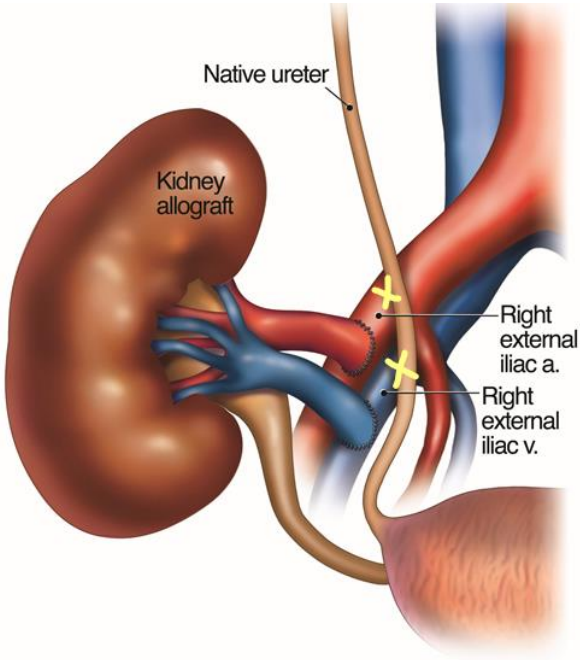
- Color image of sagittal kidney to show perfusion throughout
- MFI/MVI image of sagittal kidney to show perfusion throughout
- Document entire length of main renal artery with color Doppler and determine lie of vessel and number of arteries present.
- Document entire length of the main renal vein with color Doppler and determine lie of vessel and the number of veins present.
- Evaluate for arterial venous fistulas (AVF) in patients with hematuria or if a bruit is heard on exam. Renal biopsy is the most common cause of AVF, the inferior pole will be the most likely location of AVF caused by renal biopsy.
    - AVF will be seen as an area of aliasing on color Doppler images that will persist with increased color Doppler scale.
    - Measure size of area where aliasing is seen.
    - Use spectral Doppler to sample the area. Waveforms will show turbulent flow with high velocity and a color thrill.
    - Pulsatility can be seen in renal veins when a AVF is present

PULSED WAVE/SPECTRAL DOPPLER IMAGES TO OBTAIN

SWEEP SPEED should be set to SLOW (36cm/s) on the Philips machines and 2 or 3 on the GE machines. You will be asked to repeat images if this is not the case. It is critical for comparison to priors to have the settings consistent.

EXTERNAL ILIAC VESSELS: *VELOCITY w/ angle correction*

- Iliac artery velocity superior to the MRA anastomosis and within 2 cm of anastomosis.
- Iliac vein velocity superior to the MRV anastomosis and within 2 cm of anastomosis.



INTRARENAL ARTERIES: *RESISTIVE INDEX*

Resistive Index (RI) of the intrarenal arteries at the superior, mid and inferior poles.

- Sample should be obtained within the cortex.
- The normal range for the RI is 0.50 – 0.80.
- Compare to previous exams to evaluate for changes in RI, arterial velocities, upstroke or waveform.

MAIN RENAL VEIN: *VELOCITY w/ angle correction*

- Document velocities at the anastomosis. If more than one vein, include velocities for each.
    - Normal Peak velocity in MRV is < 100 cm/s. If velocity is increased, put patient in LLD or RLD position and reevaluate for change in velocity.
    - Evaluate any other areas of vein if aliasing is seen on color Doppler or if flow in vein is turbulent.

PULSED WAVE/SPECTRAL DOPPLER IMAGES continued…

MAIN RENAL ARTERY: *VELOCITY w/ angle correction*

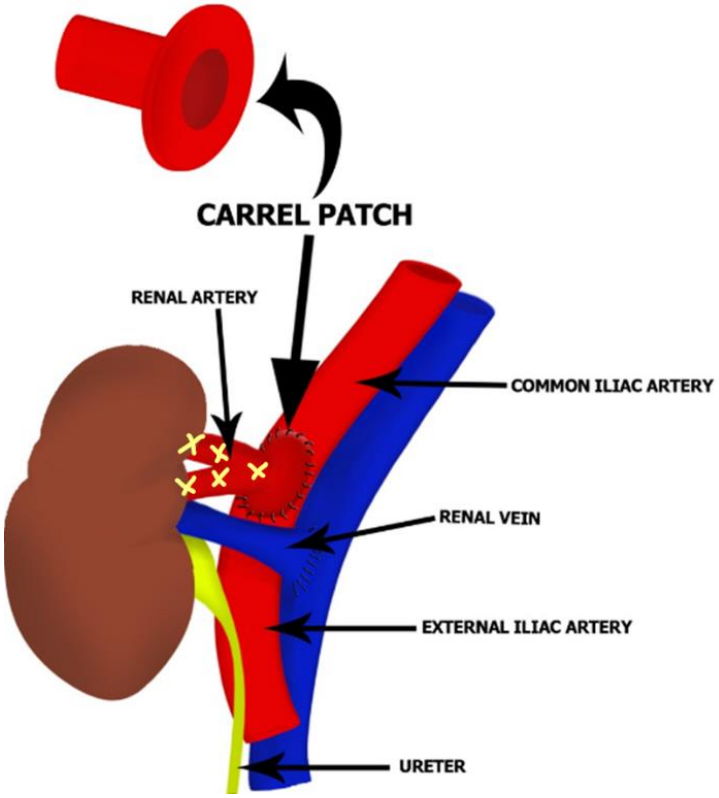
- Document velocities at distal, mid and proximal artery with angle correction. The proximal velocity should be evaluated at the anastomosis. There is often more than one main renal artery, evaluate the velocity in each according to the type of anastomosis present. *See types of graft anastomoses below for where to sample.*
  - Peak velocity in MRA should be less than 200cm/s. If velocity is greater than 350 cm/s, put patient in LLD or RLD position and reevaluate for change in velocity.
  - Compare to previous exams to evaluate for changes in arterial velocities, upstroke or waveform.

- **TYPES OF RENAL ARTERY ANASTAMOSES:**
  - **Single Artery:**
    - Document: Proximal (at the anastomosis), Mid and Distal velocities

  - **2 (or more) Arteries with Separate Anastomoses:**
    - Document: Proximal (at the anastomosis), Mid and Distal velocities for each artery.
    - Label with appropriate location, ie Superior MRA and Inferior MRA
    - Be sure to compare prior velocities to the corresponding vessel.

  - **2 (or more) Arteries on a Carrel Patch**:
    - Proximal artery at the COMMON anastomosis. Report the same velocity for both arteries. The proximal artery/anastomosis is the same for both arteries if on a Carrel Patch.
    - Separate Mid and Distal velocities for each artery.

Illustration of Carrel Patch and sample locations:

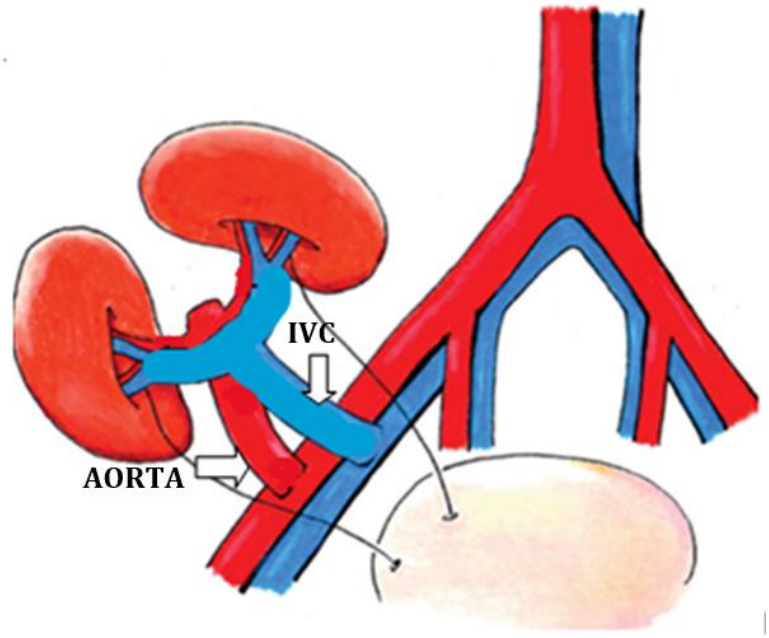


EN BLOC RENAL TRANSPLANT PROTOCOL

IMAGES TO OBTAIN

MEDIAL AND LATERAL KIDNEY TRANSPLANTS:

- Document each kidney and label its location in pelvis. (RLQ or LLQ and MEDIAL or LATERAL kidney.)
- Measure sagittal length of each kidney
- Sagittal images of medial, mid and lateral sections of each kidney
- Transverse images of upper, mid, and lower poles of each kidney
- Document presence of stent if seen.



ASSESS FOR FLUID COLLECTIONS:

- Document any fluid collections with and without color Doppler images.
- Include sagittal and transverse measurements of any collections seen.

BLADDER AND URETER:

- Sagittal and transverse 2D images. Show stent if present
- Document and measure the ureter if seen. Show stent if seen within.

COLOR DOPPLER IMAGES TO OBTAIN

- Color image of each sagittal kidney to show perfusion throughout.
- MFI/MVI image of each sagittal kidney to show perfusion throughout
- Document the donor Aorta at the anastomosis to the External Iliac Artery
- Document entire length of each renal artery with color Doppler
- Document the donor IVC at the anastomosis to the External Iliac Vein
- Document entire length of each renal vein with color Doppler
- Evaluate for arterial venous fistulas (AVF) in patients with hematuria or if a bruit is heard on exam. Renal biopsy is the most common cause of AVF, the inferior pole will be the most likely location of AVF caused by renal biopsy.
    - AVF will be seen as an area of aliasing on color Doppler images that will persist with increased color Doppler scale.
    - Measure size of area where aliasing is seen.
    - Use spectral Doppler to sample the area. Waveforms will show turbulent flow with high velocity and a color thrill.
    - Pulsatility can be seen in renal veins when a AVF is present

PULSED WAVE/SPECTRAL DOPPLER IMAGES TO OBTAIN

SWEEP SPEED should be set to SLOW (36cm/s) on the Philips machines and 2 or 3 on the GE machines. You will be asked to repeat images if this is not the case. It is critical for comparison to priors to have the settings consistent.

EXTERNAL ILIAC VESSELS: *VELOCITY w/ angle correction*

- Iliac artery velocity superior to the MRA anastomosis and within 2 cm of anastomosis
- Iliac vein velocity superior to the MRV anastomosis and within 2 cm of anastomosis

INTRARENAL ARTERIES: *RESISTIVE INDEX*

- Resistive Index (RI) of the Intrarenal arteries at the superior, mid and inferior poles of each kidney.
    - Sample should be obtained from within the cortex.
    - The normal range for the RI is 0.50 – 0.80.
    - Compare to previous exams to evaluate for changes in RI, arterial velocities, upstroke or waveform. Be sure to compare to corresponding kidney from prior exam.
    -

DONOR ARTERIES: *VELOCITY w/ angle correction*

- **Proximal Aorta:** Velocity taken at the anastomosis to external iliac artery. Report the same velocity for both kidneys. The proximal artery/anastomosis is the same for both kidneys.
- **Mid Aorta:** Velocity taken just proximal to the bifurcation of the main renal arteries. Report this velocity for both kidneys. Since the mid artery sample should be sampled within the Aorta, it is the same for both kidneys.
- **Distal Renal Arteries**: Velocity taken at the hilum of each kidney
    - Peak velocity in MRAs and donor Aorta should be less than 200cm/s with appropriate angle correction. If velocity is above 350cm/s, put patient in LLD or RLD position and reevaluate for change in velocity.
    - Compare to previous exams to evaluate for changes in arterial velocities, upstroke or waveform.

DONOR VEINS:

- **IVC:** Velocity at anastomosis to external iliac vein. Report this velocity for both kidneys. The proximal artery/anastomosis is the same for both kidneys.
    - Normal Peak velocity in MRV and IVC is < 100 cm/s. If velocity is increased, put patient in LLD or RLD position and reevaluate for change in velocity.
    - Evaluate MRV of donor IVC if other areas of aliasing are seen on color Doppler or if flow in vein is turbulent.

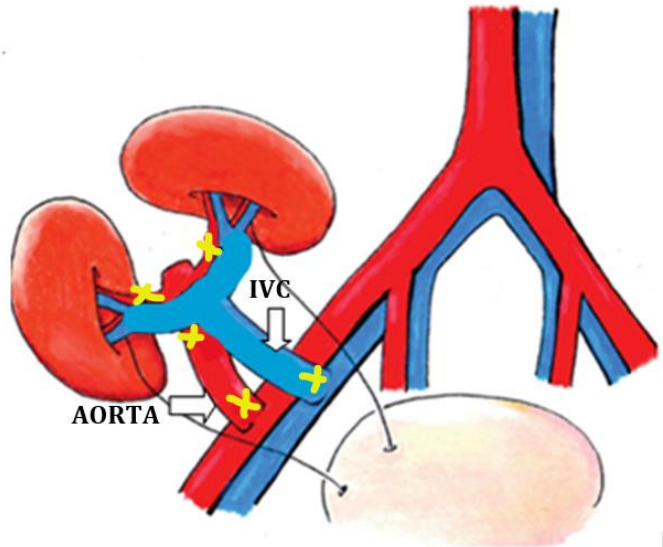
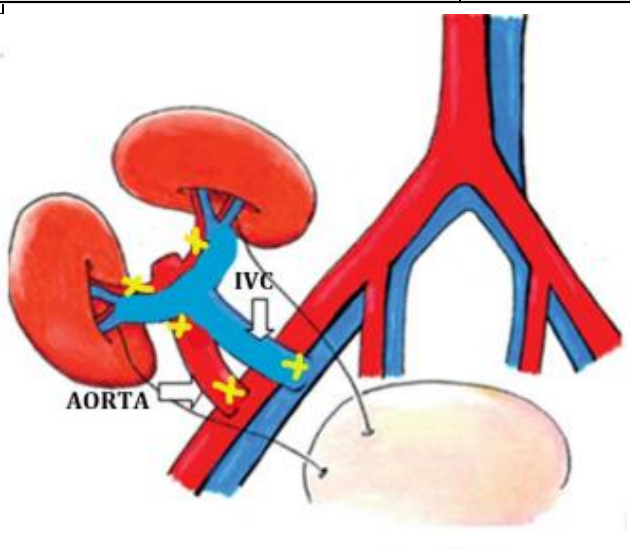


Illustration of En bloc sample locations:

EN BLOC RENAL TRANSPLANT IMAGE LIST

IMAGE	MODE
Lateral Kidney Sag Mid	2D
Lateral Kidney Sag Mid w/ measurement	2D +
Lateral Kidney Sag w/ color for perfusion	Color
Lateral Kidney Sag w/ MFI for perfusion	MFI
Lateral Kidney Sag Med	2D
Lateral Kidney Sag Lat	2D
Lateral Kidney Trans Sup	2D
Lateral Kidney Trans Mid	2D
Lateral Kidney Trans Inf	2D
Eval for AVF if hematuria, bruit, pulsatile veins or recent biopsy	*Color*
Medial Kidney Sag Mid	2D
Medial Kidney Sag Mid w/ measurement	2D +
Medial Kidney Sag w/ color for perfusion	Color
Medial Kidney Sag w/ MFI for perfusion	MFI
Medial Kidney Sag Med	2D
Medial Kidney Sag Lat	2D
Medial Kidney Trans Sup	2D
Medial Kidney Trans Mid	2D
Medial Kidney Trans Inf	2D
Eval for AVF if hematuria, bruit, pulsatile veins or recent biopsy	*Color*
Eval for fluid collections under new incisions and around transplants	2D/Color
Medial Kidney Superior Arcuate Artery RI	Spectral RI
Medial Kidney Mid Arcuate Artery RI	Spectral RI
Medial Kidney Inferior Arcuate Artery RI	Spectral RI
Lateral Kidney Superior Arcuate Artery RI	Spectral
Lateral Kidney Mid Arcuate Artery RI	Spectral
Lateral Kidney Inferior Arcuate Artery RI	Spectral

IMAGE	MODE
Lateral MRA length mapped with color	Color
Lateral MRA Distal *velocity w angle correction*	Spectral cm/s
Medial MRA length mapped with color	Color
Medial MRA Distal *velocity w angle correction*	Spectral cm/s
Donor Aorta & Anast mapped with color	Color
Donor Aorta Mid Vessel *velocity w angle correction*	Spectral cm/s
Donor Aorta Prox at EIA Anast *velocity w angle correction*	Spectral cm/s
Repeat in LLD if artery >350cm/s	Spectral cm/s
Repeat Distal MRAs if multiple arteries to either kidney	*Spectral cm/s*
Donor IVC at EIV Anast *velocity w angle correction*	Spectral cm/s
Repeat in LLD if vein >100cm/s	Spectral cm/s
MRV hilum or areas of aliasing if needed	*Spectral cm/s*
External Iliac Artery (superior to anastomosis) *velocity w angle correction*	Spectral cm/s
External Iliac Vein (superior to anastomosis) *velocity w angle correction*	Spectral cm/s
Stent - kidney end if present	2D
Stent - bladder end if present	2D
Bladder Sag	2D
Bladder Trans	2D
Bladder jet if hydro	*Color*
Post void if hydro	*2D*



RENAL TRANSPLANT IMAGE LIST

IMAGE	MODE
Kidney Sag Mid	2D
Kidney Sag Mid w/ measurement	2D +
Kidney Sag w/ color for perfusion	Color
Kidney Sag w/ MFI for perfusion	MFI
Kidney Sag Med	2D
Kidney Sag Lat	2D
Kidney Trans Sup	2D
Kidney Trans Mid	2D
Kidney Trans Inf	2D
Eval for AVF if hematuria, bruit, pulsatile veins, or recent biopsy	Color
Eval for fluid collections under new incisions and around transplant	2D/Color
Superior Kidney Arcuate Artery RI	Spectral RI
Mid Kidney Arcuate Artery RI	Spectral RI
Inferior Kidney Arcuate Artery RI	Spectral RI
MRA length mapped	Color
MRA Distal *velocity w angle correction*	Spectral cm/s
MRA Mid *velocity w angle correction*	Spectral cm/s
MRA Prox/Anast *velocity w angle correction*	Spectral cm/s
Repeat in LLD if artery >350cm/s	Spectral cm/s
Repeat if multiple arteries	
MRV length mapped	Color
MRV Anast *velocity w angle correction*	Spectral cm/s
Repeat in LLD if vein >100cm/s	Spectral cm/s
MRV hilum or areas of aliasing if needed	*Spectral cm/s*
Repeat if multiple veins	
External Iliac Artery (superior to anastomosis) *velocity w angle correction*	Spectral cm/s
External Iliac Vein (superior to anastomosis) *velocity w angle correction*	Spectral cm/s
Stent -kidney end if present	2D
Stent -bladder end if present	2D
Bladder Sag	2D
Bladder Trans	2D
Bladder jet if hydro	*Color*
Post void if hydro	*2D*

RENAL TRANSPLANT PROTOCOL HISTORY

	Date	Changes made	By whom
Updated	03/2019		Becky Marion
Updated	05/05/2022	-Format change -IlV and ILA to be sampled proximal/superior to anastomosis -Intrarenal RI to be taken in cortex -Added types of anastomosis and Carrel patch example -Changed EN Bloc image to reflect protocol	Manjiri Dighe, Renee B. Fitzgerald
Added	09/22/2022	-Added MFI for perfusion when available	Manjiri Dighe, Renee B. Fitzgerald
Added	11/1/2024	ILA and ILV to be taken superior and within 2 cm of anastomosis	Manjiri Dighe, Renee B. Fitzgerald