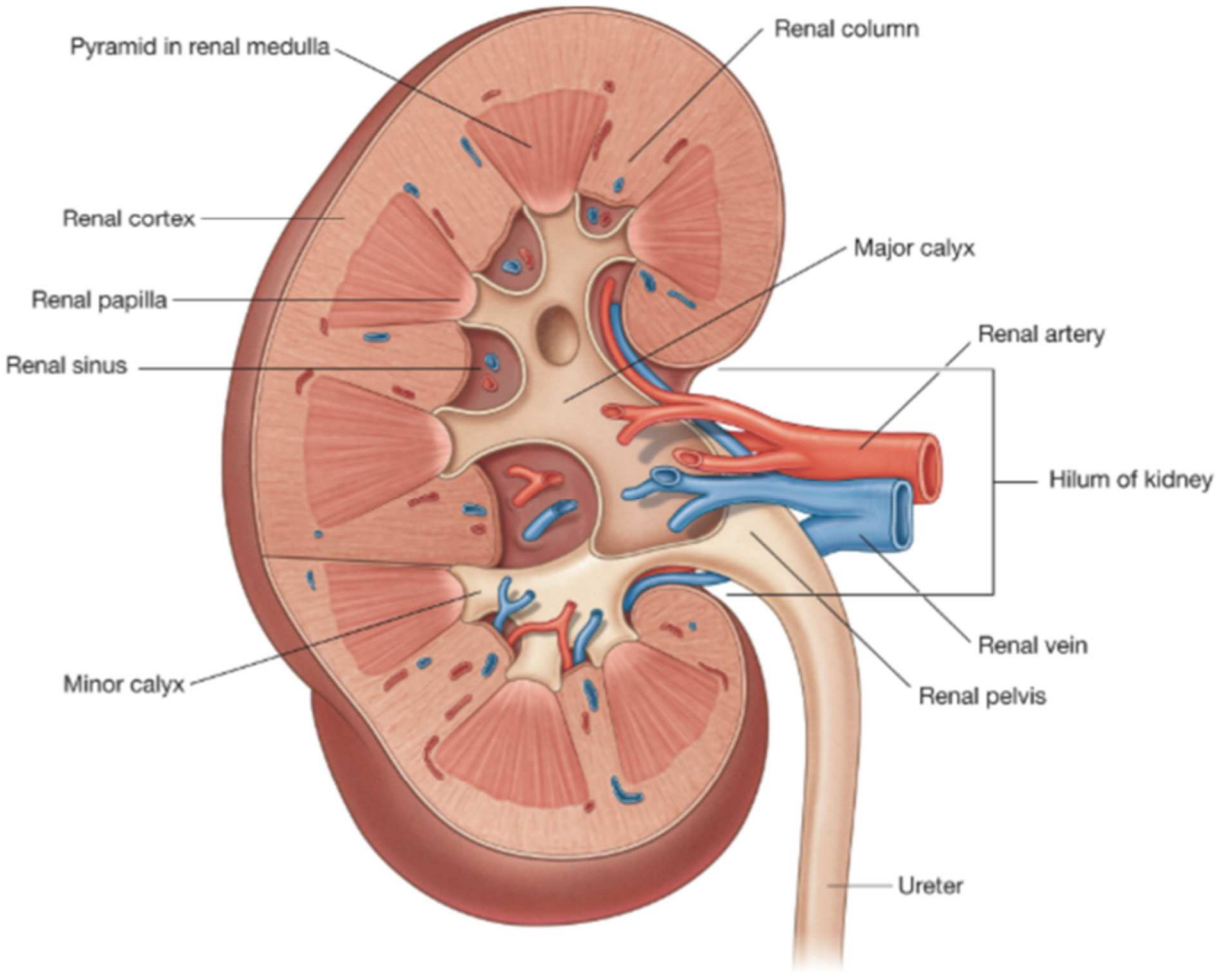
Kidney and Dialysis Imaging

SKC In-service April 2016

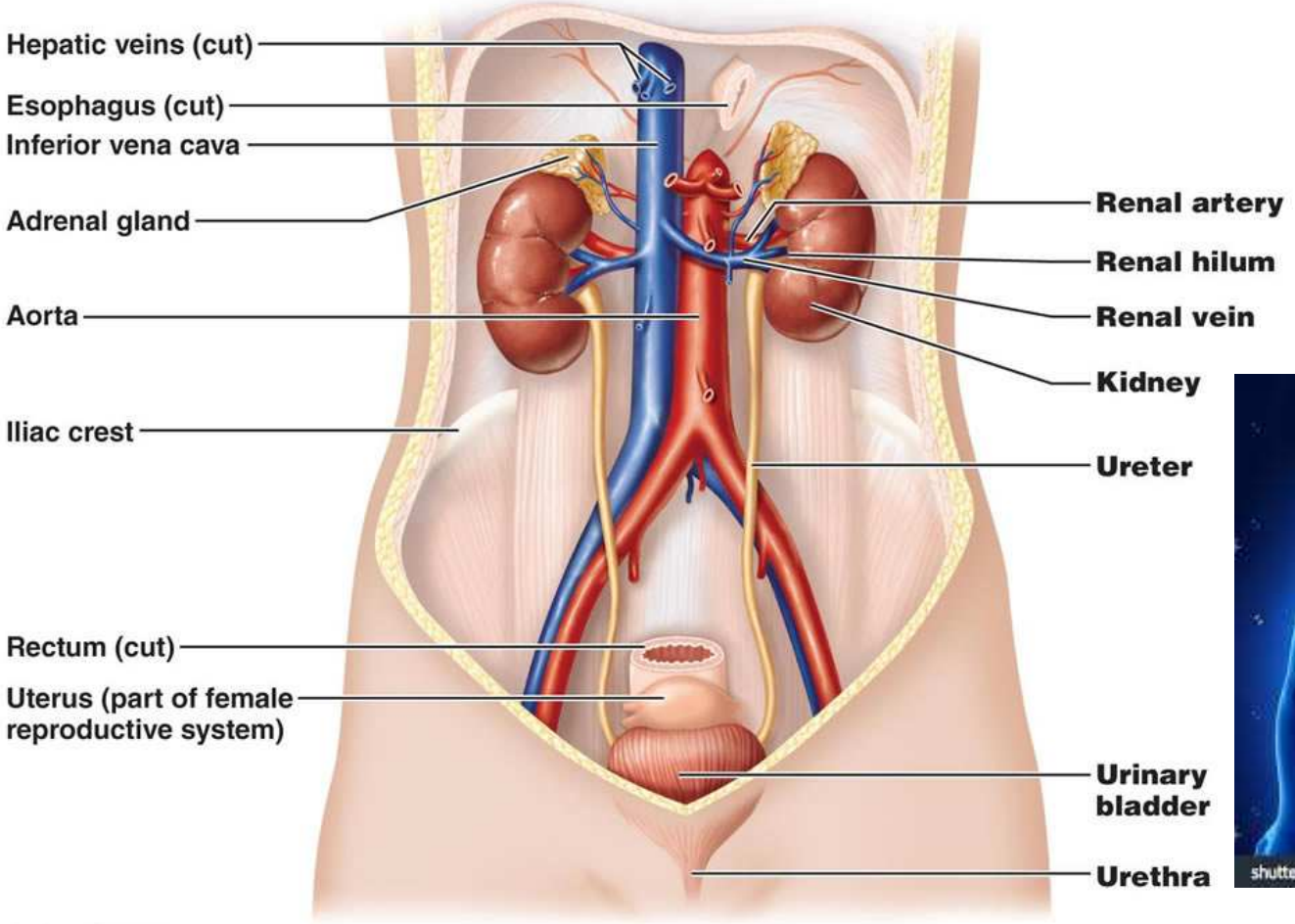
Ways to look at the kidneys

- Ultrasound
- Radioisotope imaging
- Computed Tomography (CT or CAT scan)
- Magnetic Resonance Imaging (MRI scan)
- Renal Artery or Vein Angiogram

Kidney Anatomy



Kidney Anatomy



The kidneys can be found in a space called the retroperitoneum

Ultrasound

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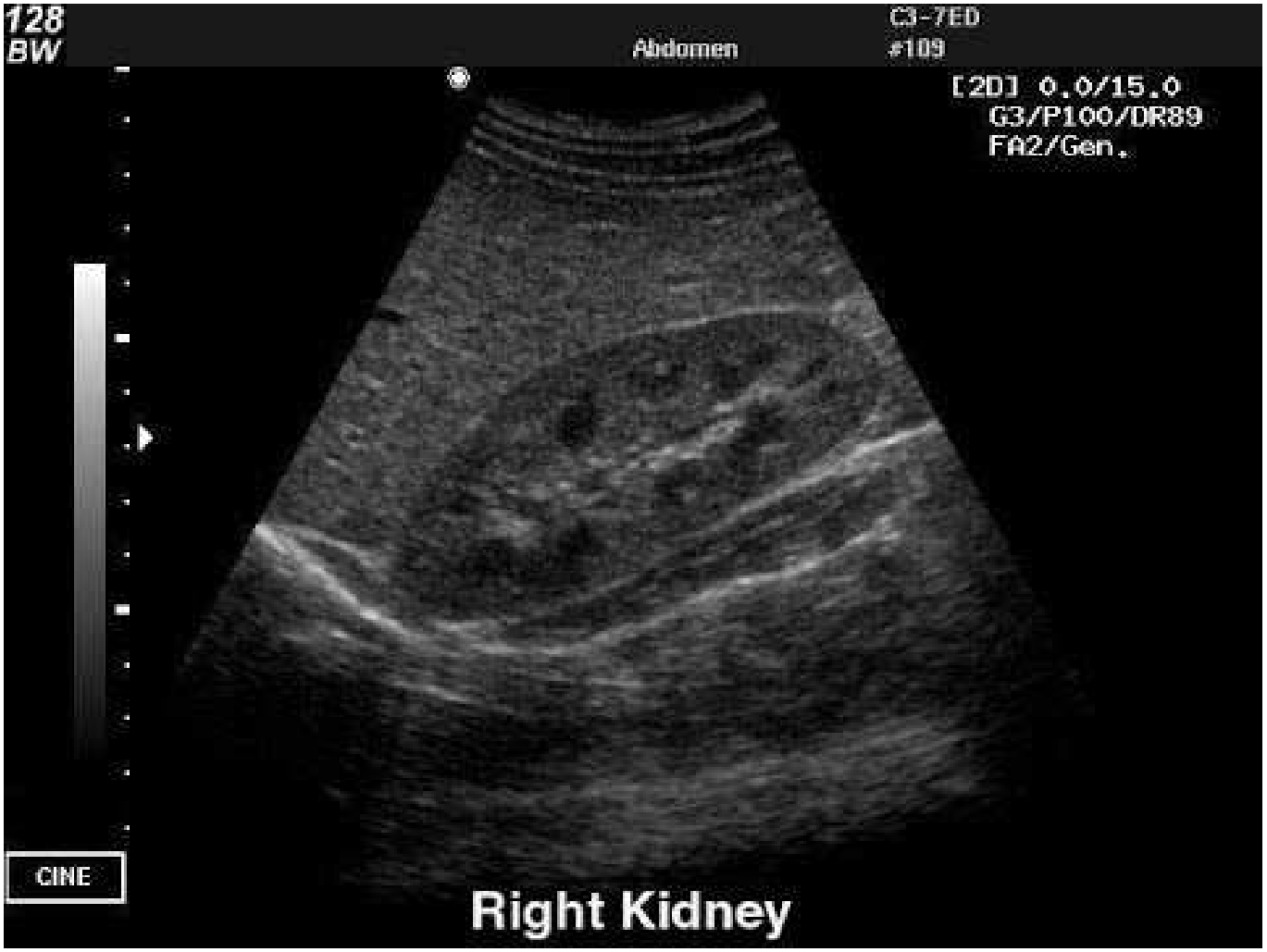
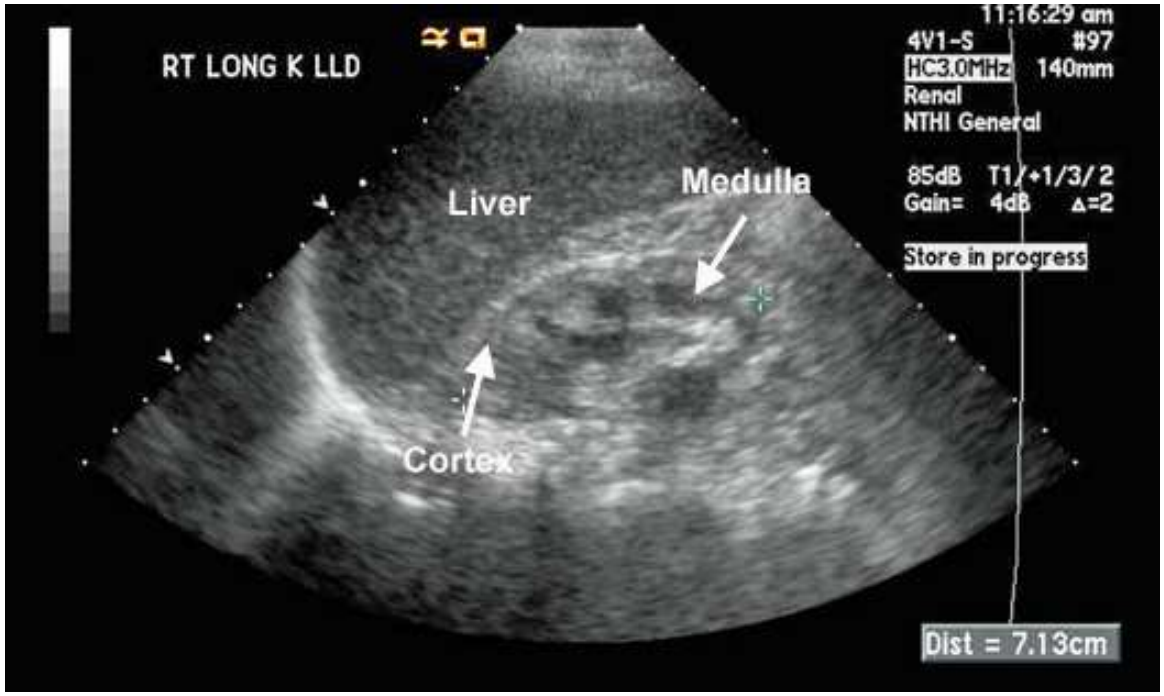
Retroperitoneal Ultrasound

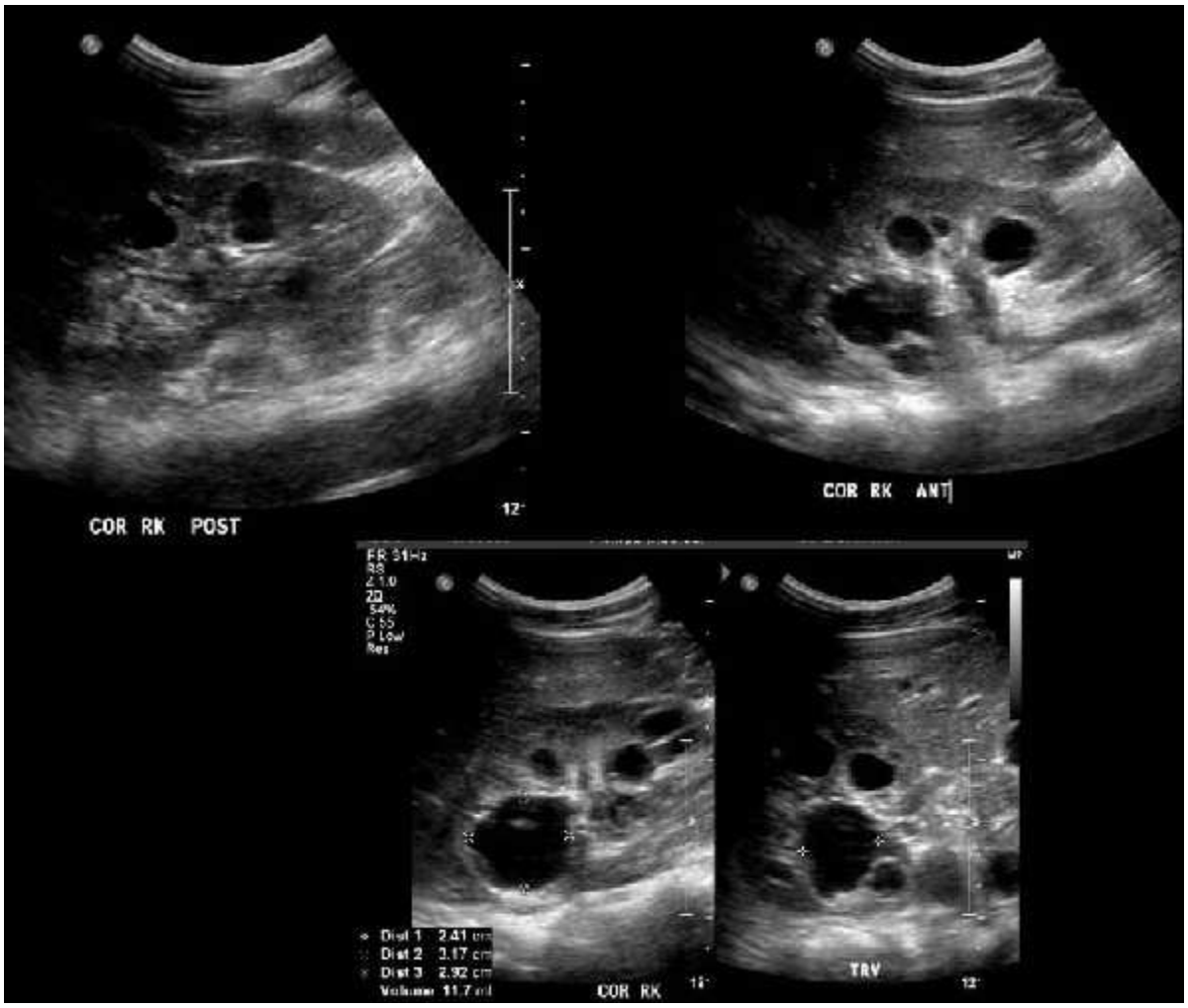


Chronic Kidney Disease Ultrasound

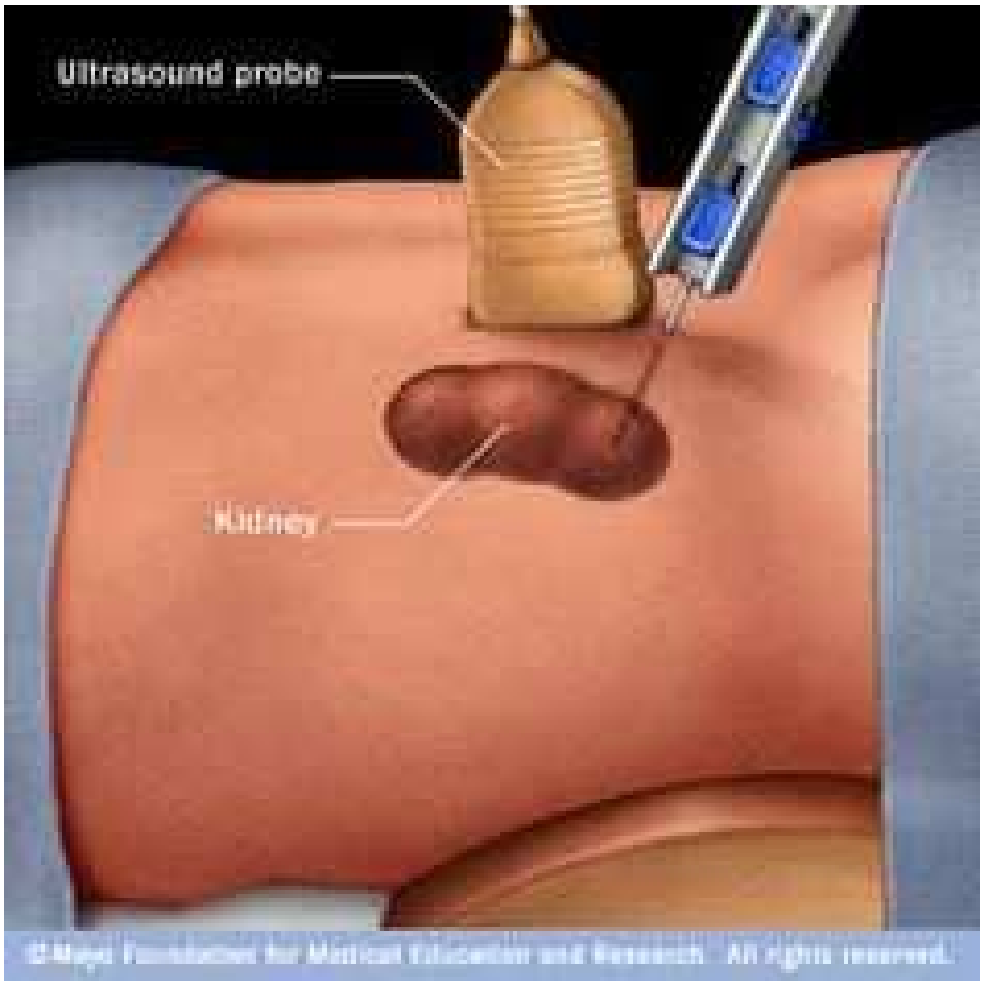


- Normal kidneys ~9-12cm depending upon size and height of the patient
- Diseased kidneys shrink in size and cortex thins out (< 2cm)

Example of Polycystic Kidney

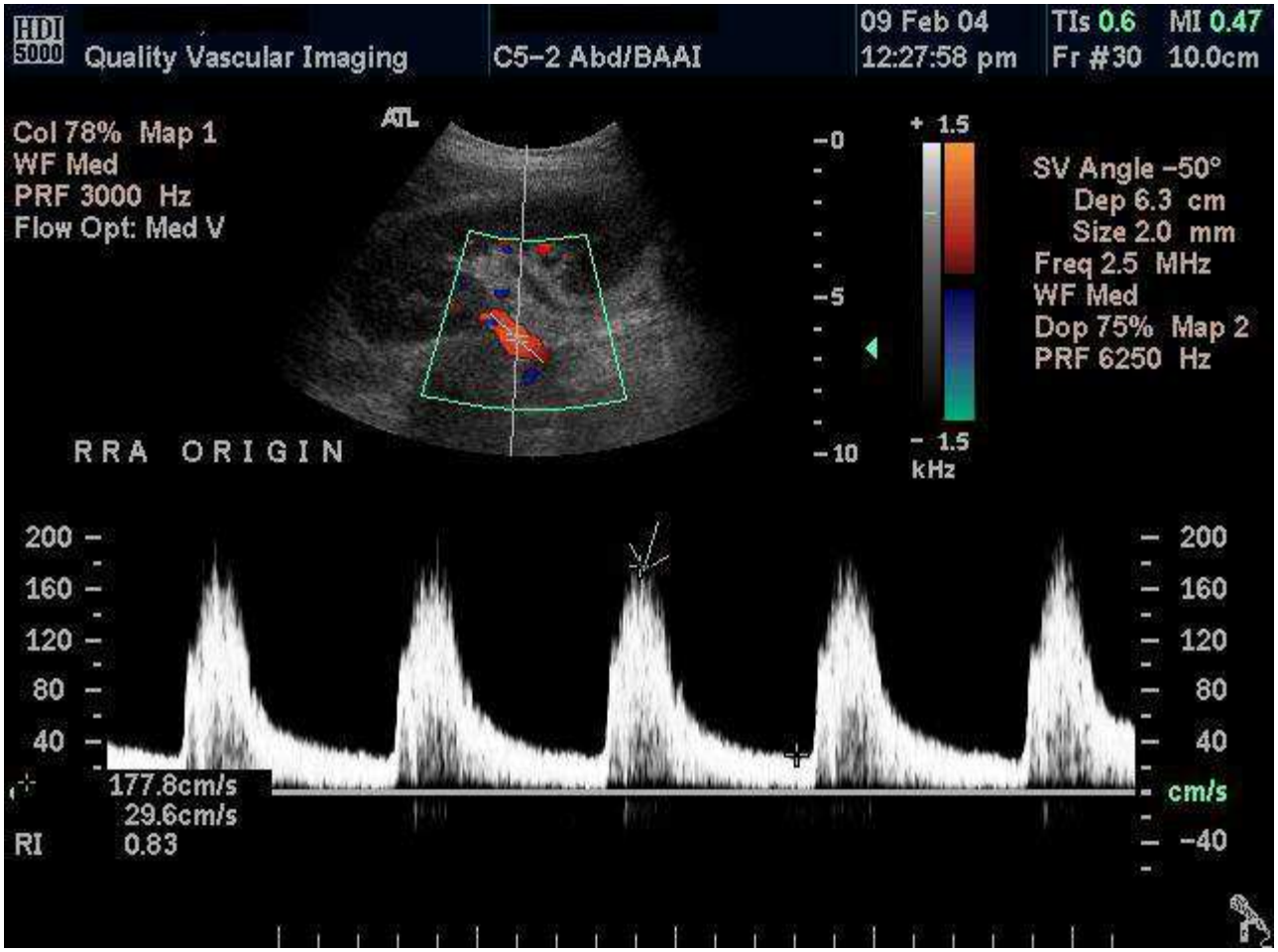


How we do kidney biopsies



Ultrasound guidance is commonly used. Some providers will use a CT scanner to guide the needle. Depends upon the expertise at your hospital.

Doppler of Renal Arteries

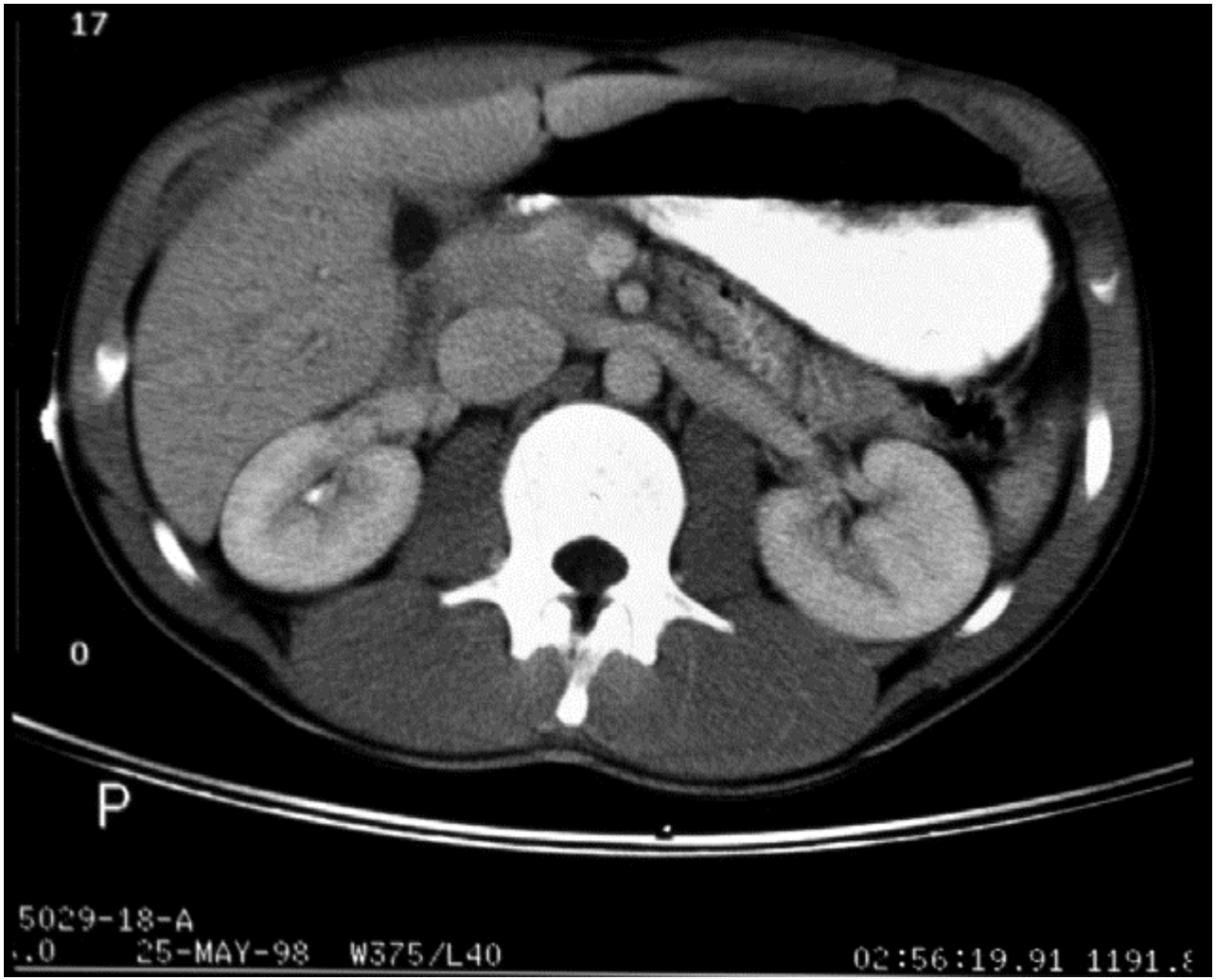


Used to assess blood flow through the renal artery. Can help identify stenosis.
Note: Renal artery stenosis can cause hypertension.

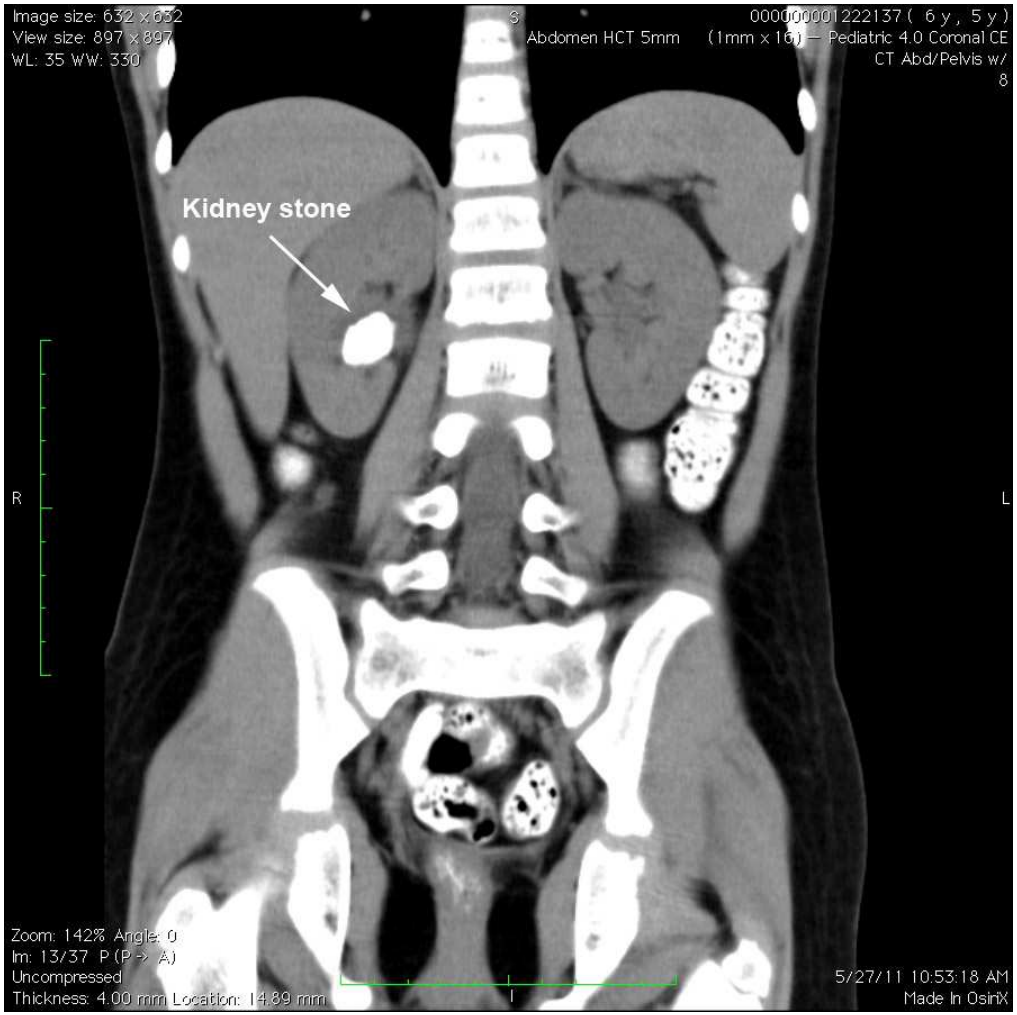
CT Scanning

Requires radiation (like X-ray). May require contrast injection.
Contrast has been associated with kidney injury in some studies (but not all)

CT Scan of Kidneys

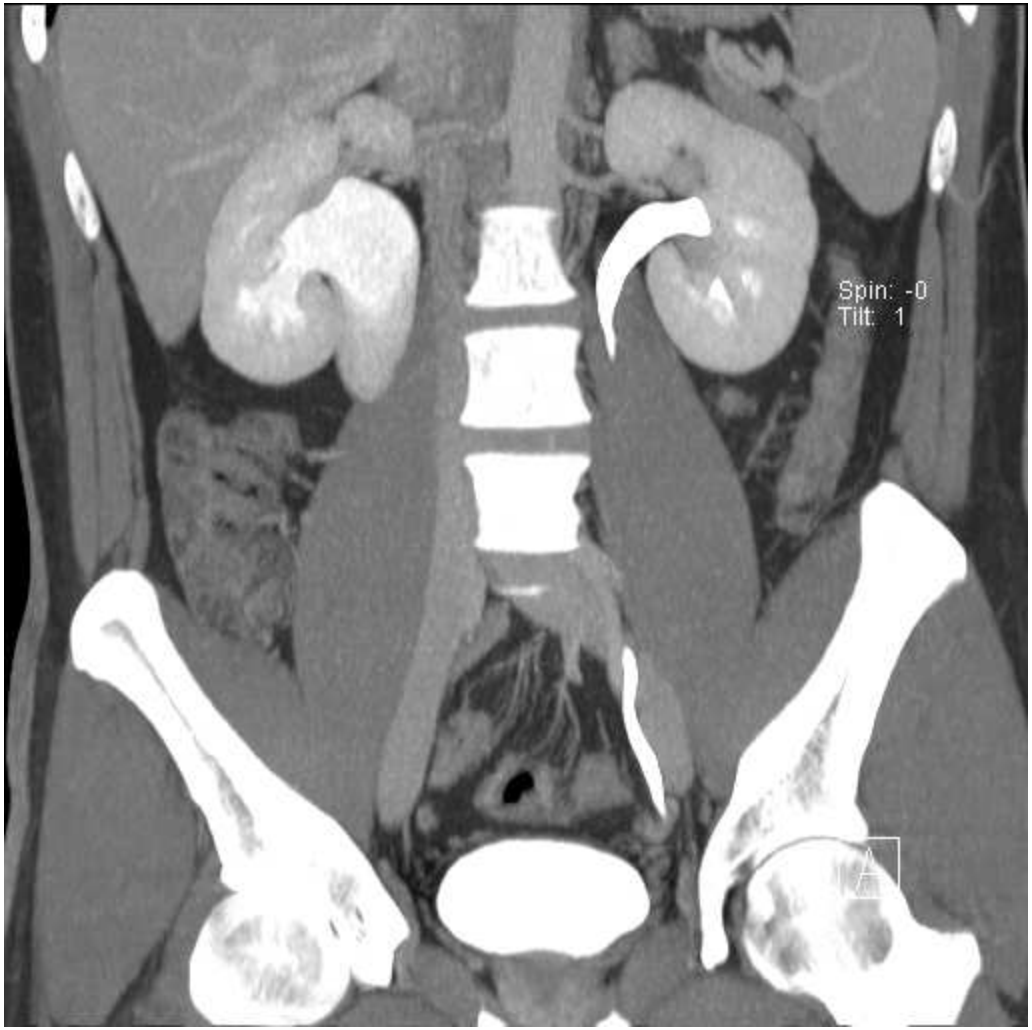


CT Scan of Kidneys



Autosomal Dominant Polycystic Kidney Disease

Hydronephrosis



Chronic Kidney Disease

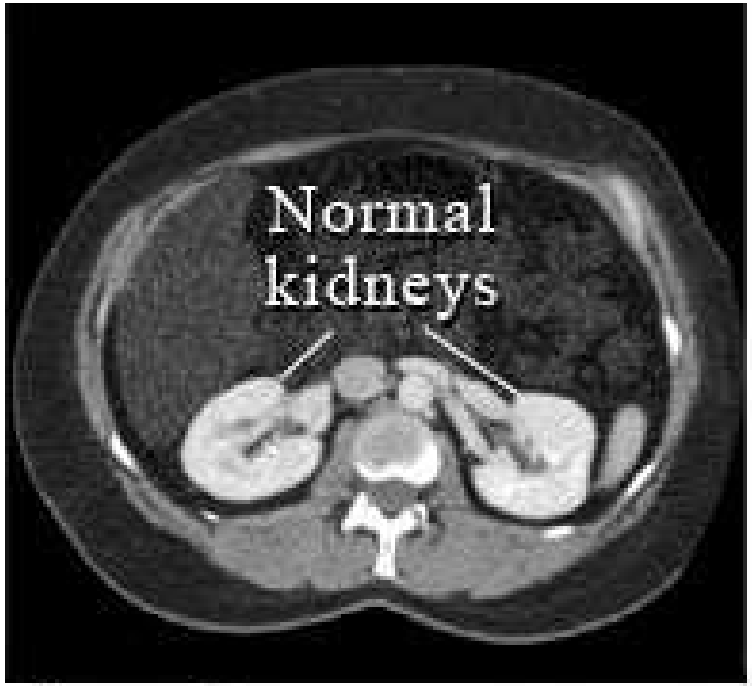
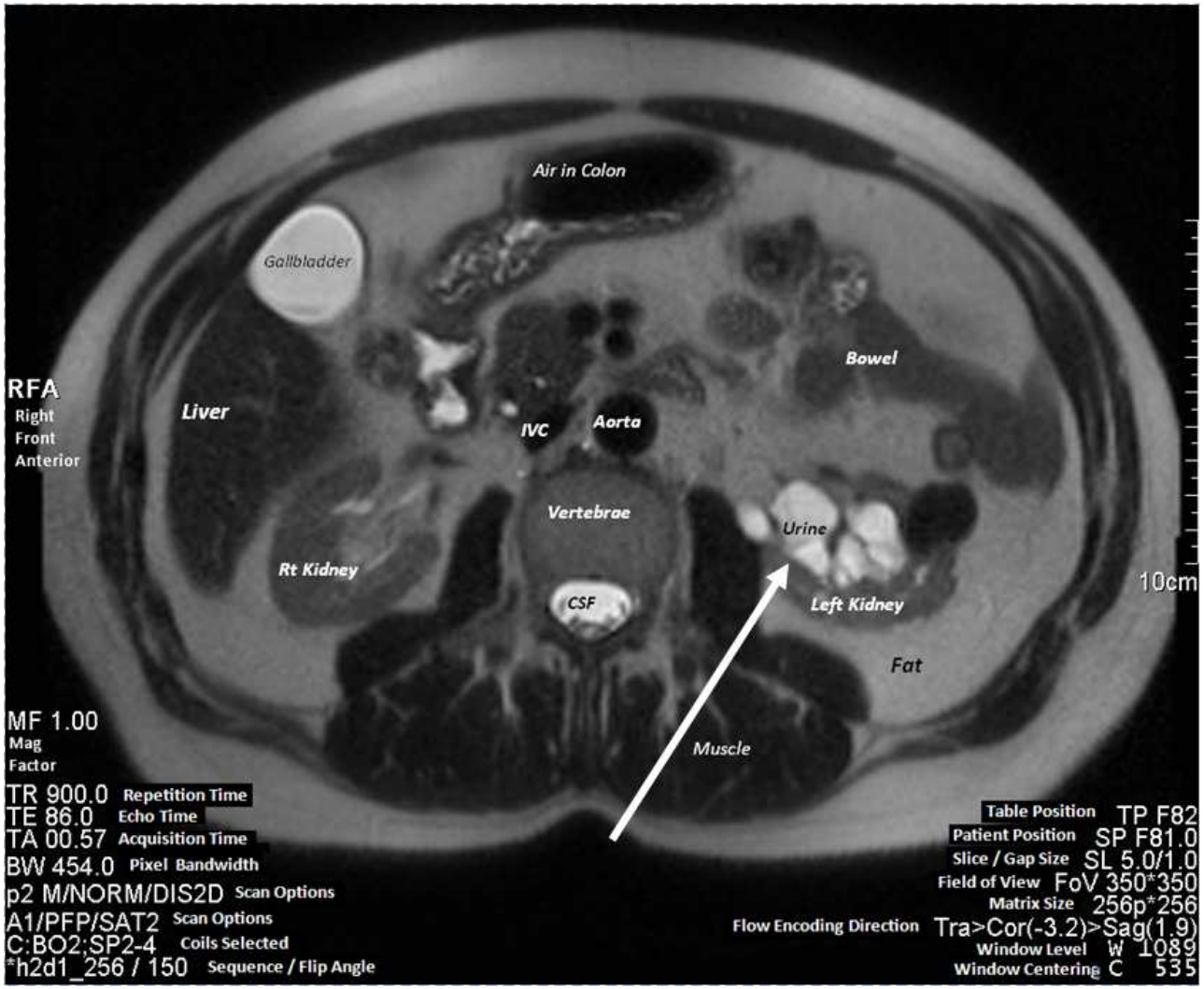


Figure 1

Figure 2

MRI Scan of Kidneys



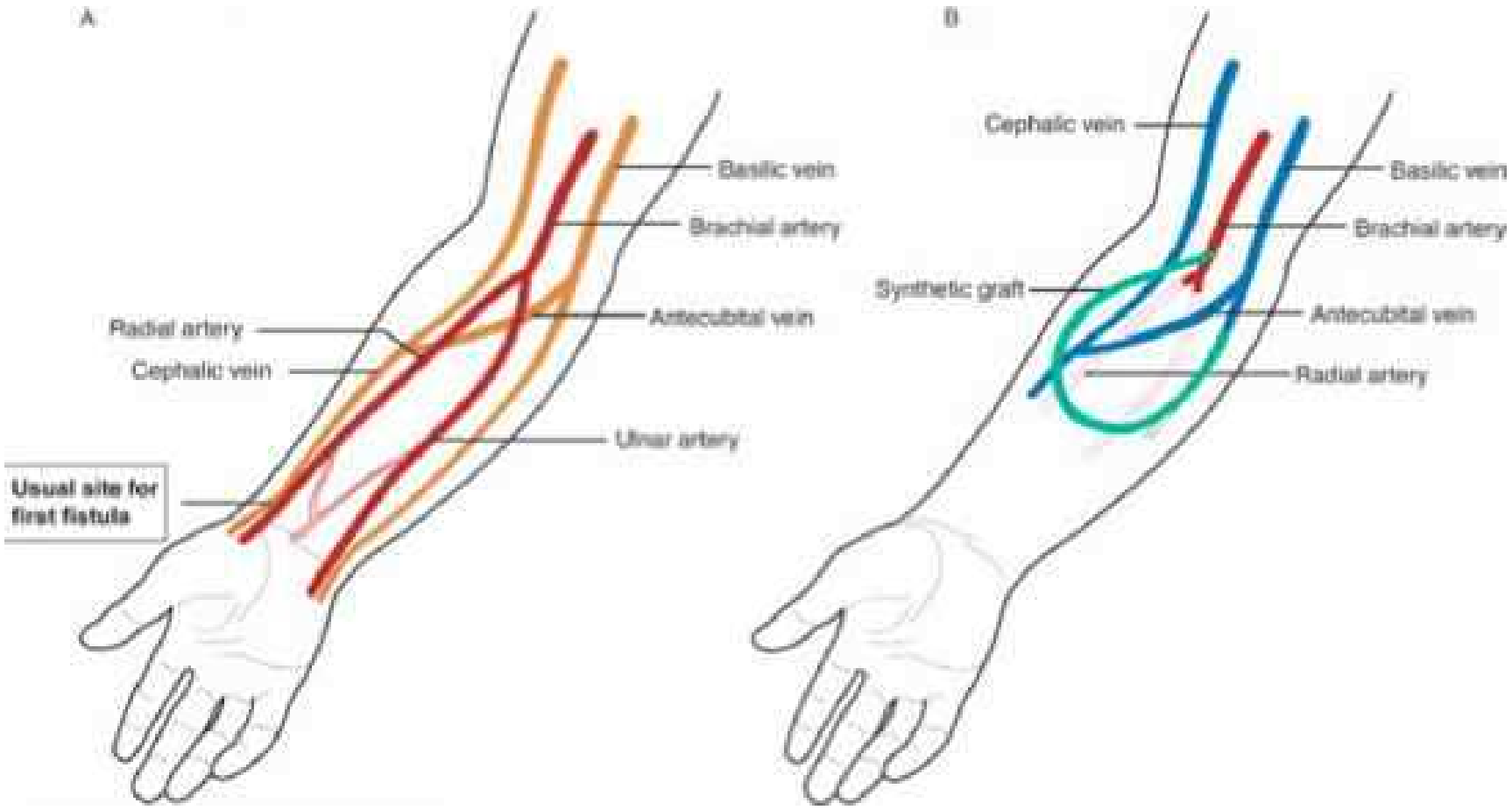
MRI scans can be done with or without contrast. The contrast material used is Gadolinium. In general we try to avoid gadolinium in CKD and ESRD patients.

Nephrogenic Systemic Fibrosis

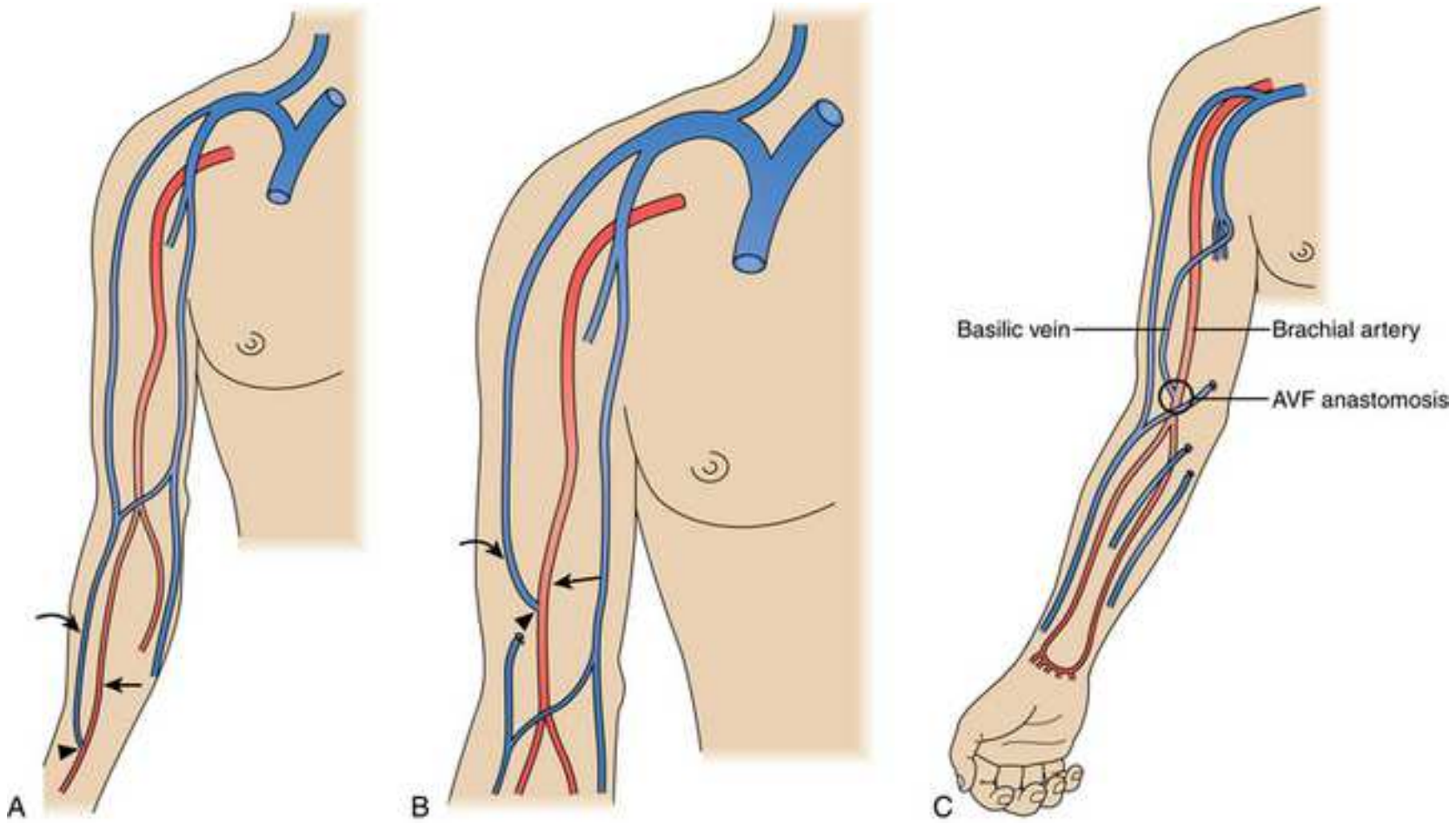
Ways to look at the access

- Ultrasound
- Doppler Ultrasound
- Angiogram

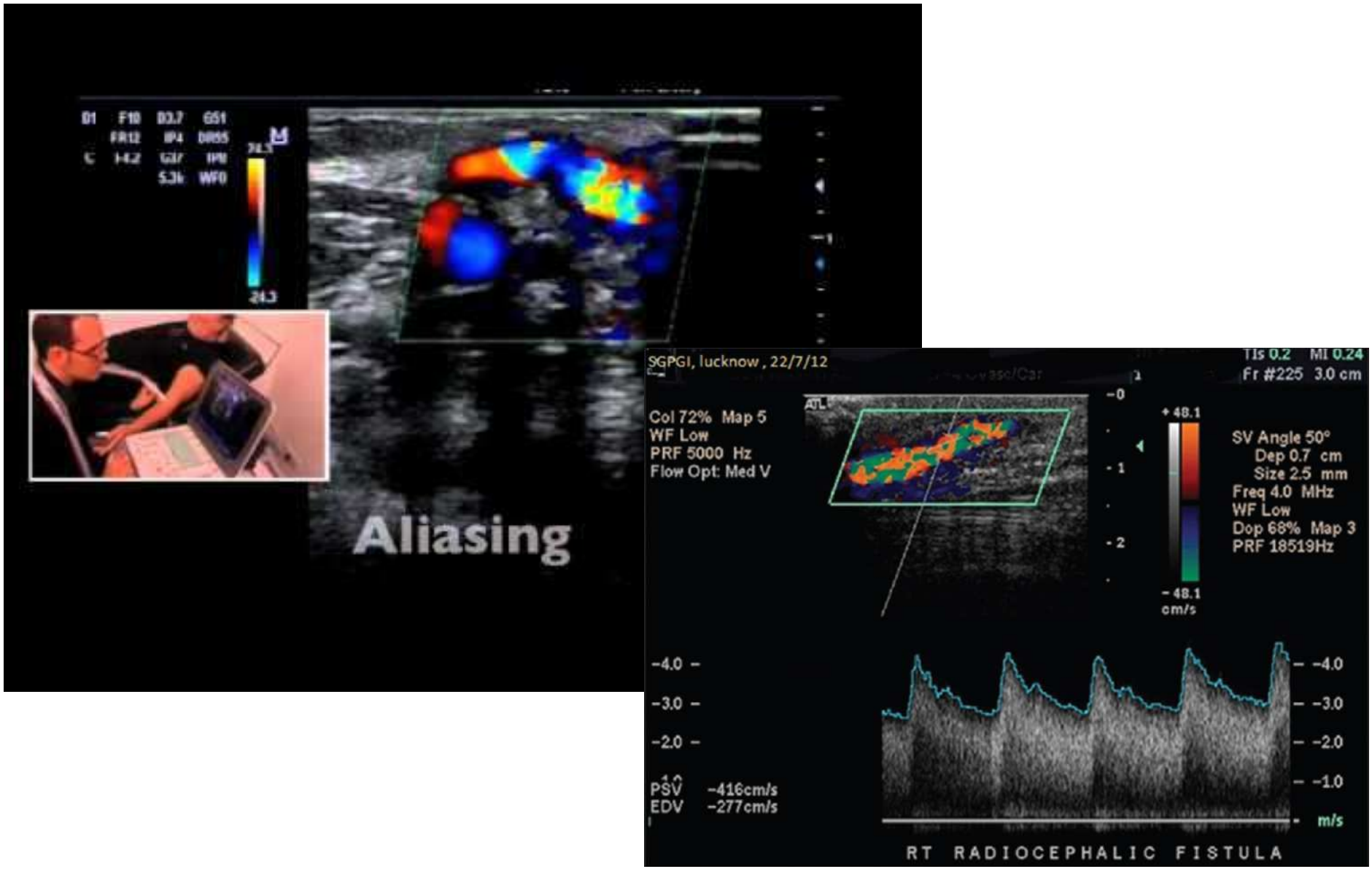
Fistula / Graft Anatomy Forearm



Fistula / Graft Anatomy Upper Arm



Ultrasound Dialysis Fistula



Example Dopper US readout

- Upper Extremities
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Lt prox subclavian A PSV 332 cm/s
Lt axillary A PSV 138 cm/s
Lt prox brachial A PSV 206 cm/s
Lt mid brachial A PSV 257 cm/s
Lt distal brachial A PSV 464 cm/s
Other: Dialysis Access Fistula:
Site of anastomosis---Distal upper arm, brachial artery to basilic vein.
Anastomosis Velocity----------466 cm/s
Anastomosis Diameter---------0.55 cm
Large Venous Side Branches within 10 cm of the fistula anastomosis------N

Upper Extremities
==========

Lt int jugular V: complete compression, complete color fill, spontaneous, phasic flow, pulsatile flow, no intraluminal echoes visualized on B-mode image
Lt subclavian V: complete color fill, spontaneous, phasic flow, pulsatile flow, no intraluminal echoes visualized on B-mode image
Lt brachiocephalic V: complete color fill, spontaneous, phasic flow, pulsatile flow, no intraluminal echoes visualized on B-mode image
Lt axillary V: complete color fill, spontaneous, phasic flow, pulsatile flow, no intraluminal echoes visualized on B-mode image
Lt brachial V: complete compression
Other: Superficial Venous Outflow:
Basilic vein is the primary outflow conduit of the dialysis access fistula. It is seen to be of irregular caliber and somewhat tortuous through the upper arm, with multiple areas of diameter related velocity elevation. Diameter changes include 1.61-0.74-1.11 cm, 1.32-0.80-1.67 cm, 1.37-0.91-1.94 cm.
Velocity increases include 150-474 cm/s, 149-398 cm/s.

Fistula Diameter: 0.74-1.94 cm (optimal greater than0.50 cm)
Fistula Depth: 0.27-0.99 cm (optimal less than0.60 cm)
Estimated Superficial Conduit Length: greater than10 cm (optimal greater than10 cm)

Calculated Volume Flow:
Inflow brachial artery----------1622-1779 ml/min
Outflow basilic vein: near AVF anastomosis----1948 ml/min
Outflow basilic vein: proximal upper arm--------2987-3983 ml/min

Volume Flow Ranges: Low (less than600 ml/min), Acceptable (600-800 ml/min), High (greater than800 ml/min)

Impression
==========

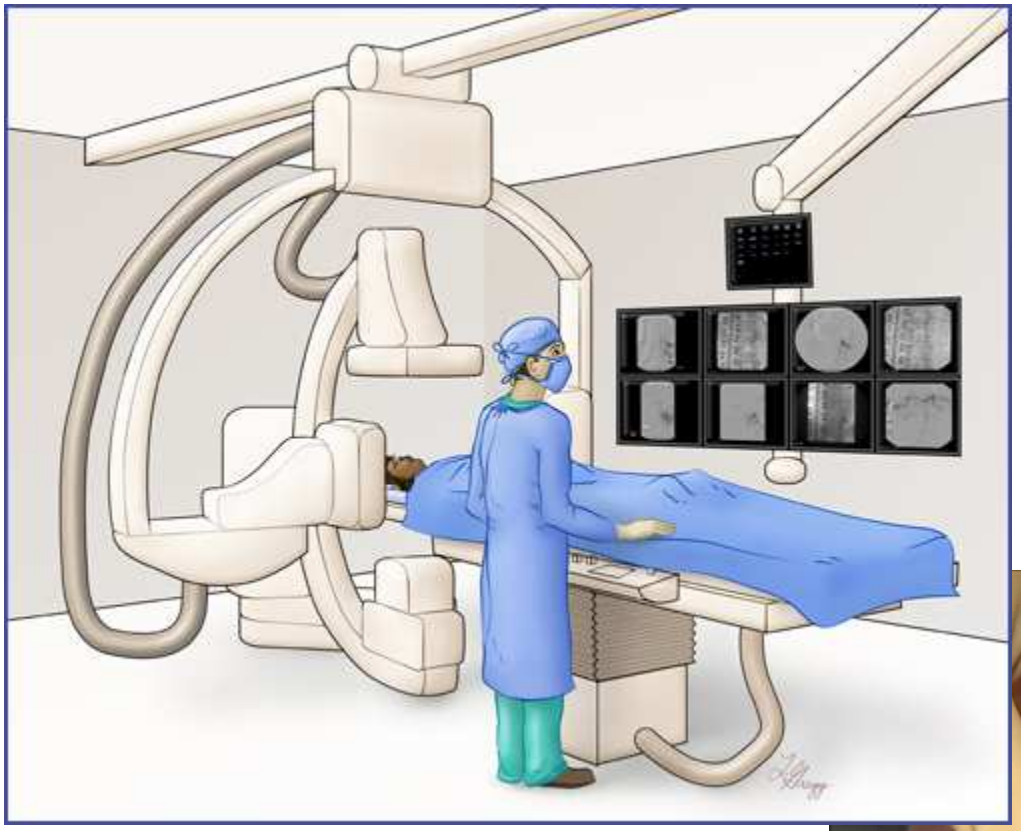
No significant change compared to the previous examination on 6/9/2015. New observations are noted regarding basilic vein caliber irregularity.

1. Patent left upper extremity dialysis access fistula.
-Basilic vein is the primary outflow conduit of the dialysis access fistula. It is seen to be of irregular caliber and somewhat tortuous through the upper arm, with multiple areas of diameter-related velocity elevation.
2. The fistula anastomosis measures 0.55 cm with a peak velocity of 466 cm/s.
3. No significant focal arterial inflow stenosis identified in the left upper extremity. There is diffuse 20-49% velocity elevation through the mid-distal inflow brachial artery.
4. No deep/central venous outflow stenosis identified in the left upper extremity.
5. Calculated volume flow rate in the inflow brachial artery is 1622 and 1779 ml/min.
6. Calculated volume flow rate in the outflow basilic vein:
- 1948 ml/min in the outflow basilic vein near the anastomosis
- 2987 and 3983 ml/min in the outflow basilic vein in the proximal upper arm
7. Fistula Diameter is 0.74-1.94 cm at a depth of 0.27-0.99 cm.
8. The estimated superficial (usable) conduit length is greater than 10 cm.

Normal Mature Fistula Parameters

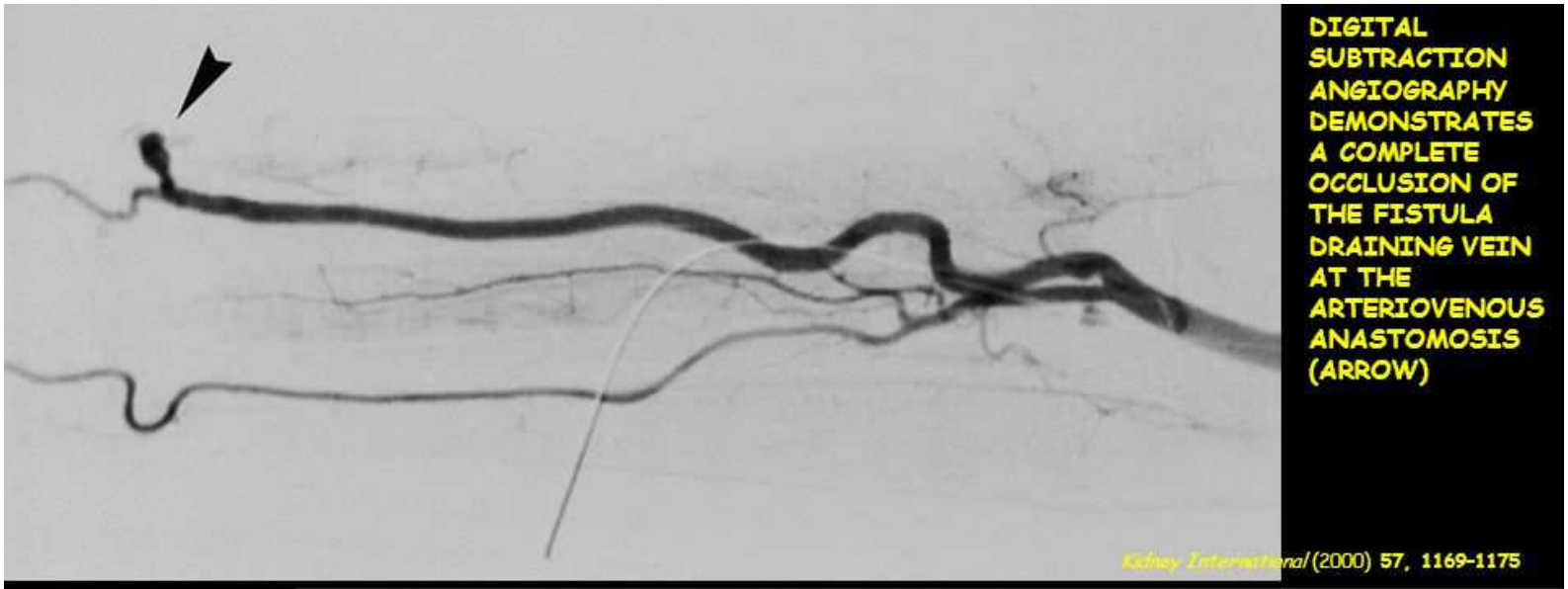
- “Rule of Sixes”
  - Diameter > 6mm
  - Depth < 6mm
  - Flow > 600 ml/min

Dialysis Access Angiogram



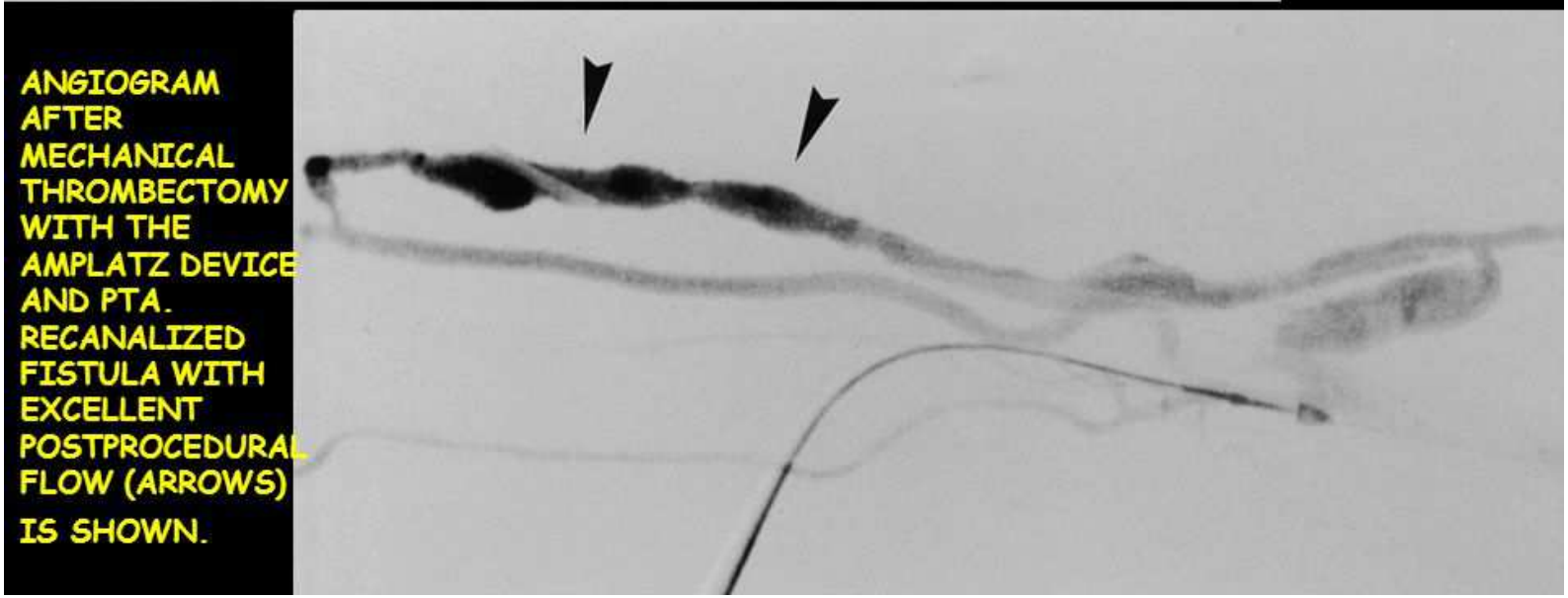
Removing 8F retrograde sheath with Z-stick

Fistula Angiogram



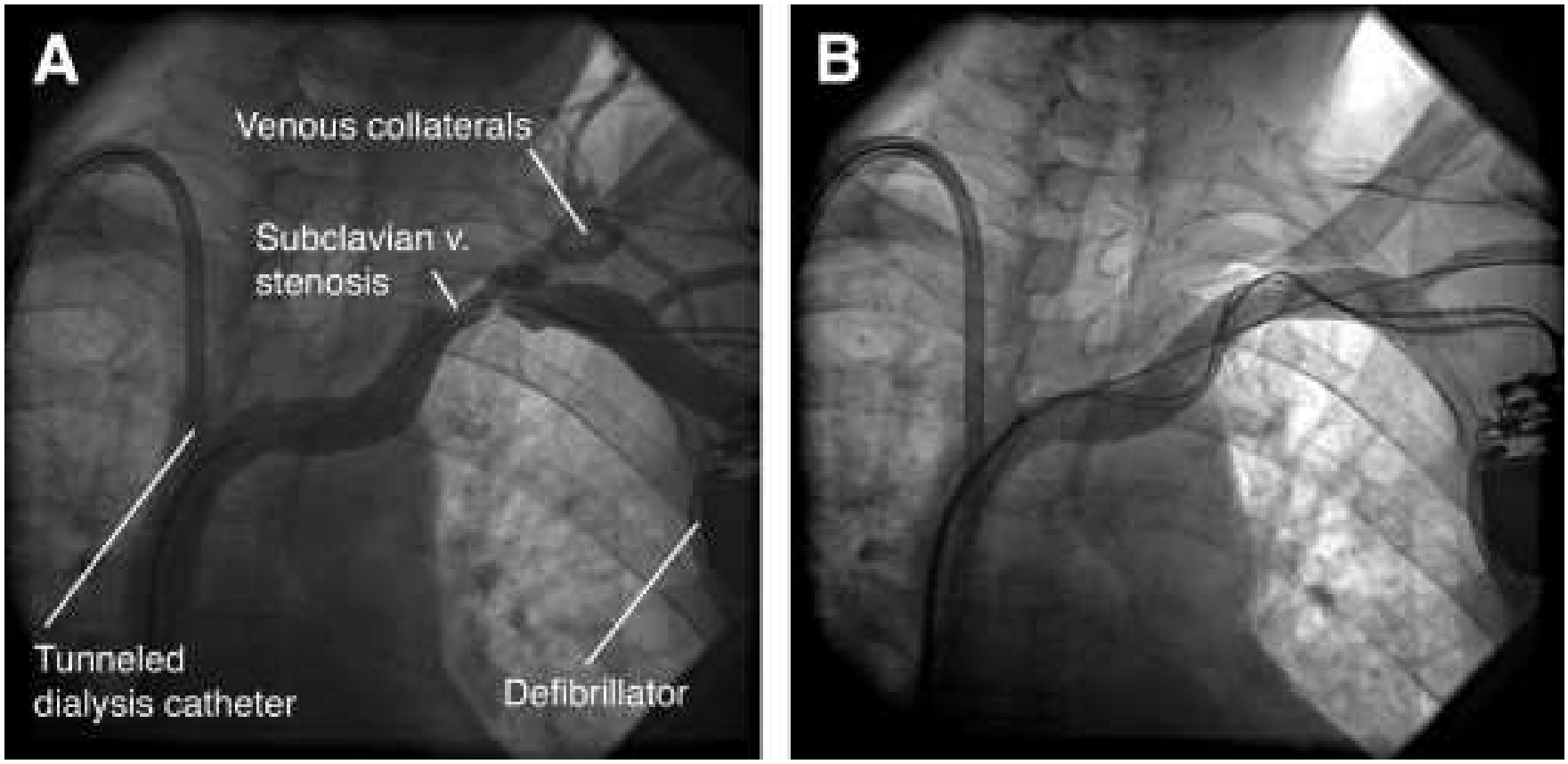
DIGITAL SUBTRACTION ANGIOGRAPHY DEMONSTRATES A COMPLETE OCCLUSION OF THE FISTULA DRAINING VEIN AT THE ARTERIOVENOUS ANASTOMOSIS (ARROW)

Kidney International (2000) 57, 1169–1175



ANGIOGRAM AFTER MECHANICAL THROMBECTOMY WITH THE AMPLATZ DEVICE AND PTA. RECANALIZED FISTULA WITH EXCELLENT POSTPROCEDURAL FLOW (ARROWS) IS SHOWN.

Fistula / Central Angiogram



Note the dialysis catheter (central line) and pacemaker. Both can cause central stenosis.

Angioplasty