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NYU Langone Health

Genitourinary Radiology

2025 AUA Annual Review Course
Houston, TX

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I have no relevant conflicts of interest to disclose.

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Dr. Matthew Young

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Outline

- Radiation & Fluoroscopy
- Basics of CT, MRI, US, & VCUG
- Nuclear Medicine
- Renal Masses & Stones
- Prostate MRI
- Adrenal Imaging
- Scrotal Imaging
- Retroperitoneal Tumors

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- **Radiation & Fluoroscopy**
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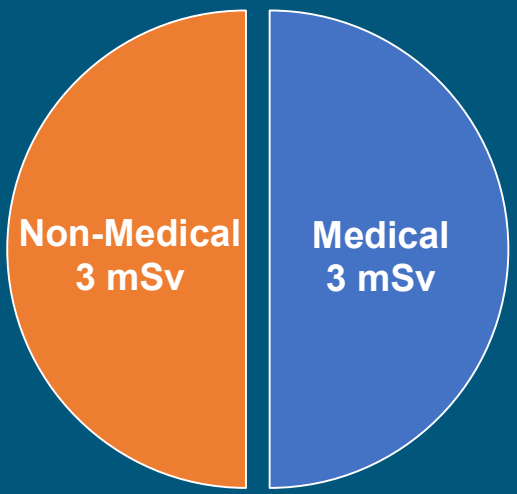
Annual Radiation Exposure

- Radon
- Terrestrial
- Internal
- Cosmic



- **CT**
- NM
- FL/XR

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Radiation Dose Examples

Dose (mSv)	Exam
10	Abdominopelvic CT
9	PCNL
7	Enema
4	IVP
1	Ureteroscopy, SWL
0.7	KUB
0.1	Chest X-Ray
0.05	Flight from NY to LA

→ 10 mSv CT in 2000 pts → 2 CA, 1 fatal
Sodickson et al Radiology 2009

→ ~5% of future CA attributable to CT
Smith-Bindman et al JAMA 2025

Limits

- 50 mSv: 1 year occupational dose limit (ICRP)
- 100 mSv: 5 year occupational dose limit
- No limit for patients

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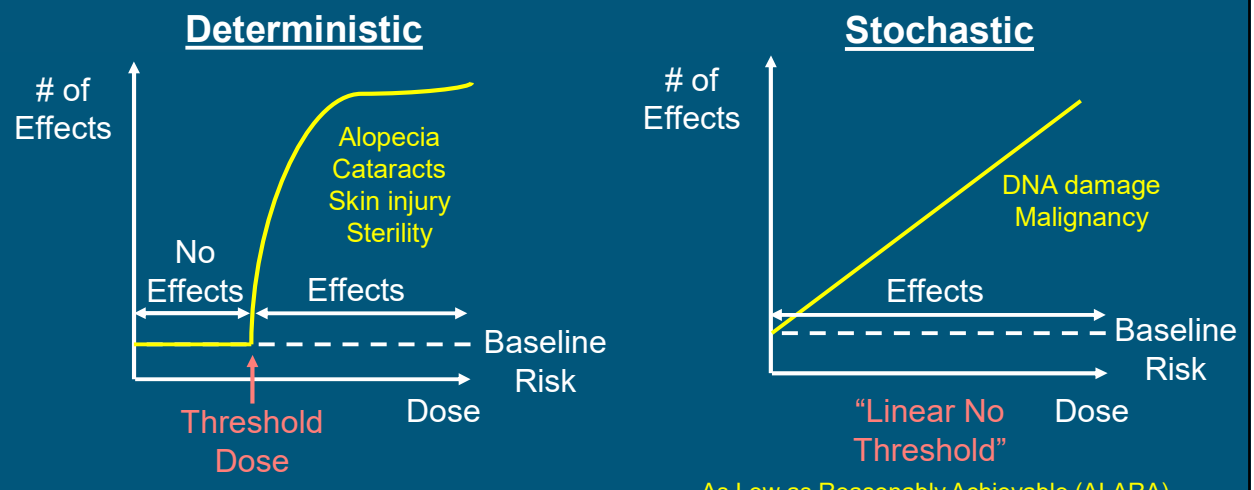
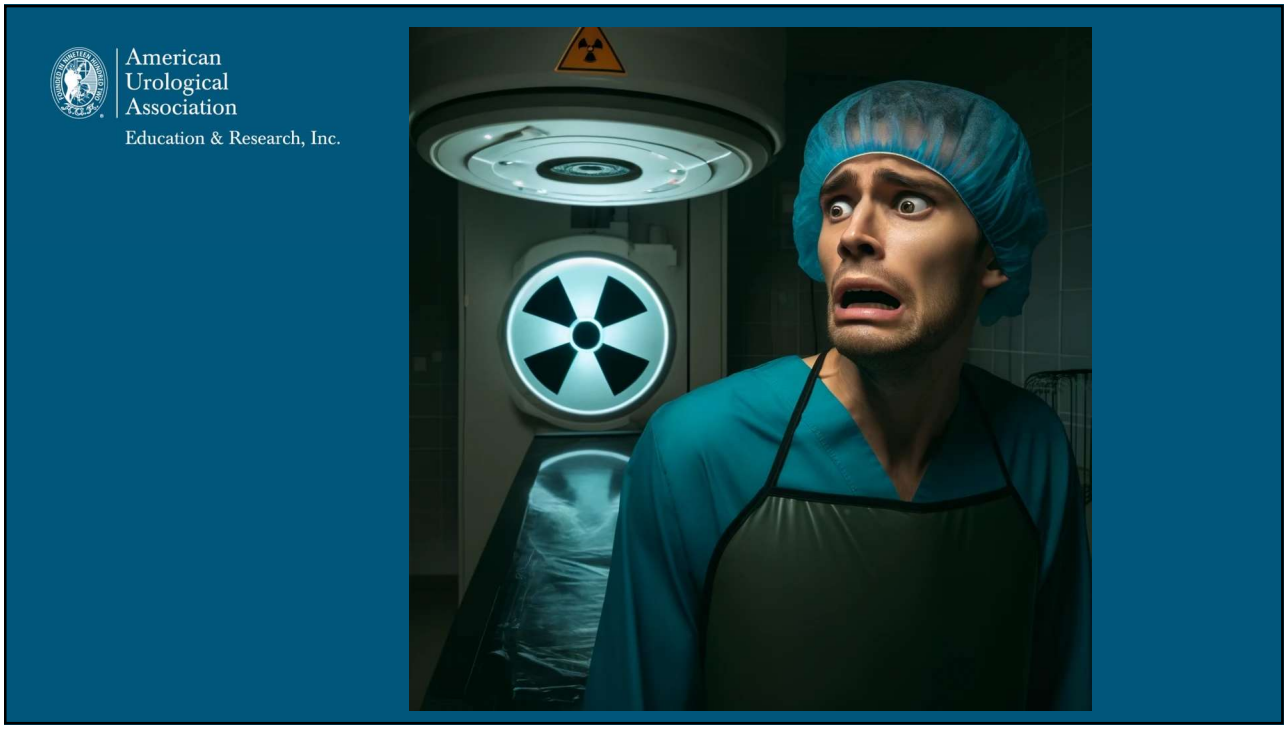
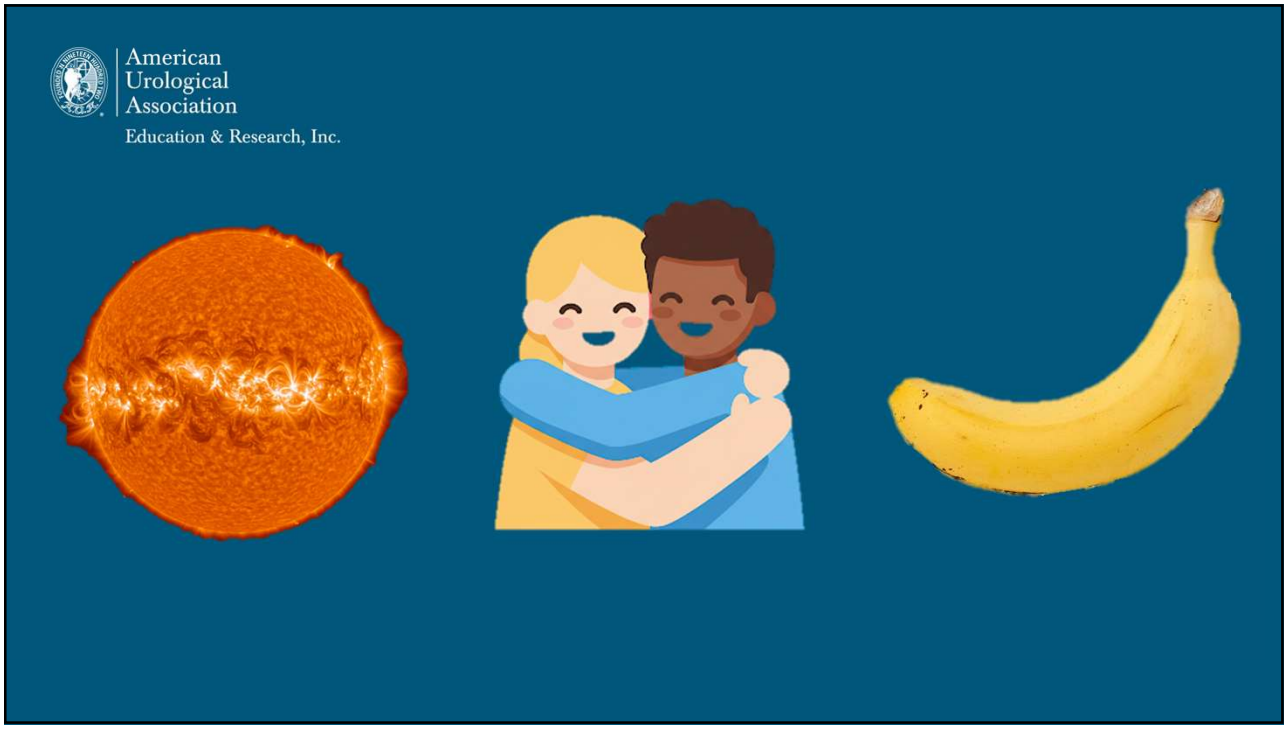
Radiation Effects







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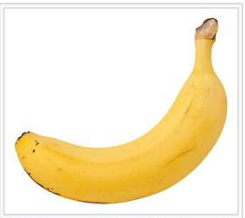
Banana equivalent dose

20 languages

Article Talk Read Edit View history Tools

From Wikipedia, the free encyclopedia

Banana equivalent dose (**BED**) is an informal unit of measurement of ionizing radiation exposure, intended as a general educational example to compare a dose of radioactivity to the dose one is exposed to by eating one average-sized banana. Bananas contain naturally occurring radioactive isotopes, particularly potassium-40 (^{40}K), one of several naturally occurring isotopes of potassium. One BED is often correlated to 10^{-7} sievert (0.1 μSv); however, in practice, this dose is not cumulative, as the potassium in foods is excreted in urine to maintain homeostasis.[1] The BED is only meant as an educational exercise and is not a formally adopted dose measurement.



A banana contains naturally occurring radioactive material in the form of potassium-40.

History [edit]

The origins of the concept are uncertain, but one early mention can be found on the RadSafe nuclear safety mailing

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"There are no published studies **directly** linking CT scans (even multiple CT scans) to cancer. Americans should **not forgo necessary, life-saving medical imaging** and **continue to discuss the benefits and risks** of these exams with their healthcare providers."

"Medical imaging exams – including CT – are a primary factor in **declining cancer death** rates, and are directly linked to **decreased hospital mortality** rates and **greater life expectancy**. Scans **reduce invasive surgeries, unnecessary hospital admissions, and length of hospital stays**."

"Before undergoing any imaging study, particularly those that involve radiation exposure, patients should ask their physician or other medical provider the following questions:
-**How will having this exam improve my health care?**
-**Are there alternatives that do not use radiation** which are equally as good (e.g. MRI, ultrasound, etc.)?
-**Is this facility ACR accredited**?"

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Fluoroscopy

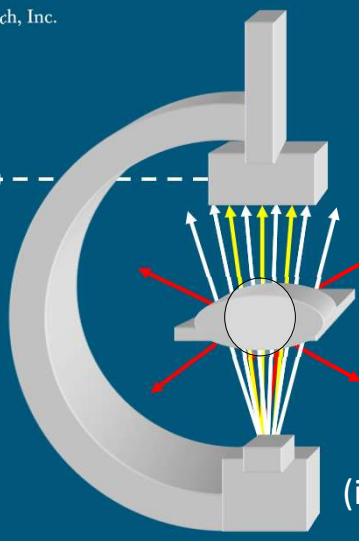

Image Intensifier (II)
or Flat Panel

Patient

X-Ray Tube
(incl. collimator)

Automatic Exposure Control:
Detects photons reaching II
and adjusts XR tube output

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Reducing Dose in Fluoroscopy

- **Fluoroscopy** (vs. full exposure)
- **Pulsed** fluoroscopy (vs. Continuous), lower frames/sec
- **Reduce magnification and digital subtraction** (requires more photons to maintain image quality)
- **Collimate** (reduces area exposed and scatter)
- **Last image hold**
- **Patient positioning**
  - In field: optimizes tube output and images
  - Thinnest patient distance
  - Close to receptor/image intensifier: decrease wasted XR

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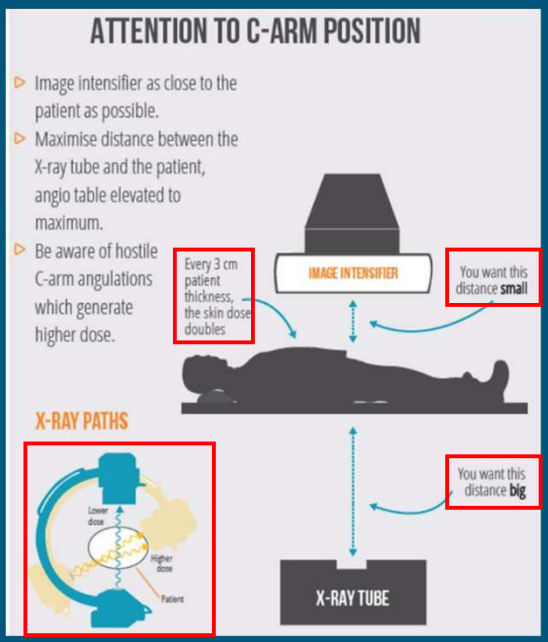

AUA Radiation Safety Awareness Manual

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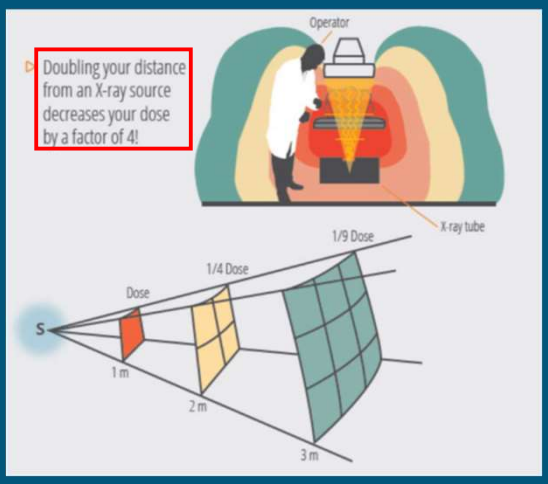
Inverse Square Law



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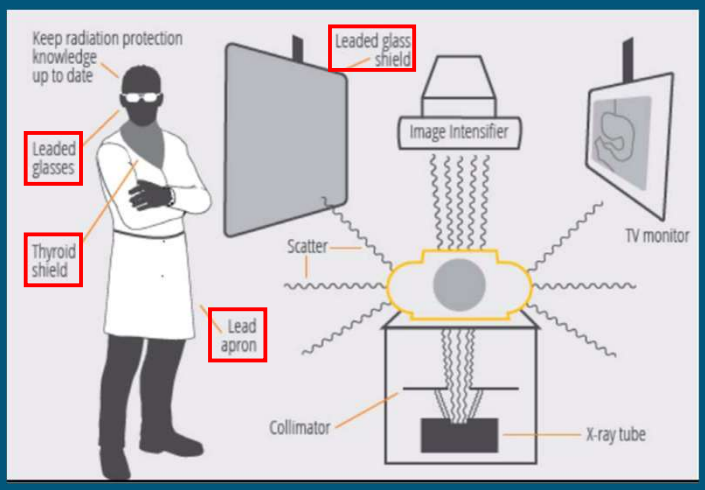
Personal Protection



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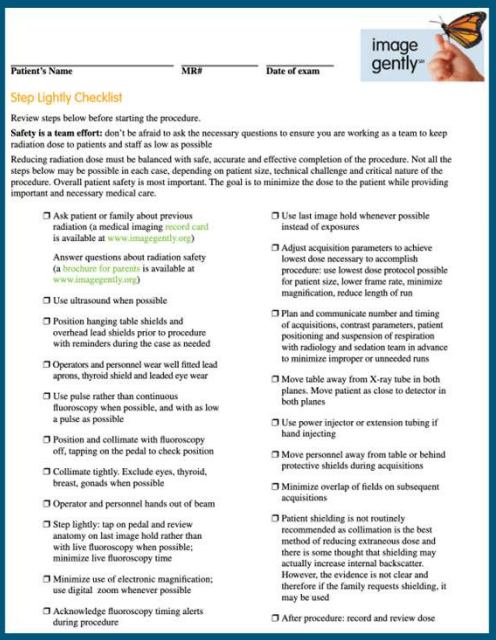

Patient's Name _____ MR# _____ Date of exam _____

image gently℠

Step Lightly Checklist

Review steps below before starting the procedure.

Safety is a team effort: don't be afraid to ask the necessary questions to ensure you are working as a team to keep radiation dose to patients and staff as low as possible

Reducing radiation dose must be balanced with safe, accurate and effective completion of the procedure. Not all the steps below may be possible in each case, depending on patient size, technical challenge and critical nature of the procedure. Overall patient safety is most important. The goal is to minimize the dose to the patient while providing important and necessary medical care.

- ❒ Ask patient or family about previous radiation (a medical imaging record card is available at www.imagegently.org)
  Answer questions about radiation safety (a brochure for parents is available at www.imagegently.org)
- ❒ Use ultrasound when possible
- ❒ Position hanging table shields and overhead lead shields prior to procedure with reminders during the case as needed
- ❒ Operators and personnel wear well fitted lead aprons, thyroid shield and leaded eye wear
- ❒ Use pulse rather than continuous fluoroscopy when possible, and with as low a pulse as possible
- ❒ Position and collimate with fluoroscopy off, tapping on the pedal to check position
- ❒ Collimate tightly. Exclude eyes, thyroid, breast, gonads when possible
- ❒ Operator and personnel hands out of beam
- ❒ Step lightly: tap on pedal and review anatomy on last image hold rather than with live fluoroscopy when possible; minimize live fluoroscopy time
- ❒ Minimize use of electronic magnification; use digital zoom whenever possible
- ❒ Acknowledge fluoroscopy timing alerts during procedure
- ❒ Use last image hold whenever possible instead of exposures
- ❒ Adjust acquisition parameters to achieve lowest dose necessary to accomplish procedure: use lowest dose protocol possible for patient size, lower frame rate, minimize magnification, reduce length of run
- ❒ Plan and communicate number and timing of acquisitions, contrast parameters, patient positioning and suspension of respiration with radiology and sedation team in advance to minimize improper or unneeded runs
- ❒ Move table away from X-ray tube in both planes. Move patient as close to detector in both planes
- ❒ Use power injector or extension tubing if hand injecting
- ❒ Move personnel away from table or behind protective shields during acquisitions
- ❒ Minimize overlap of fields on subsequent acquisitions
- ❒ Patient shielding is not routinely recommended as collimation is the best method of reducing extraneous dose and there is some thought that shielding may actually increase internal backscatter. However, the evidence is not clear and therefore if the family requests shielding, it may be used
- ❒ After procedure: record and review dose

www.imagegently.org

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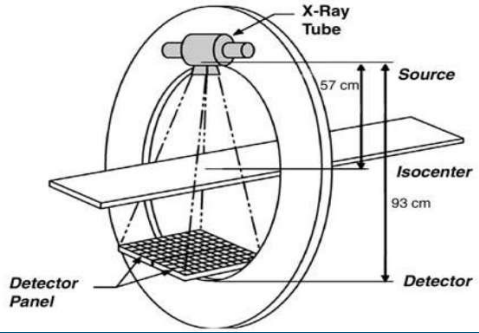
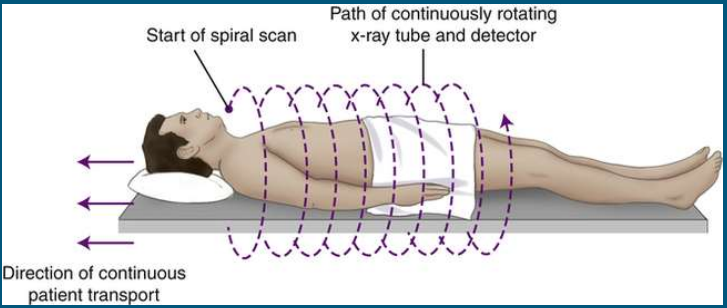
Computed Tomography (CT)





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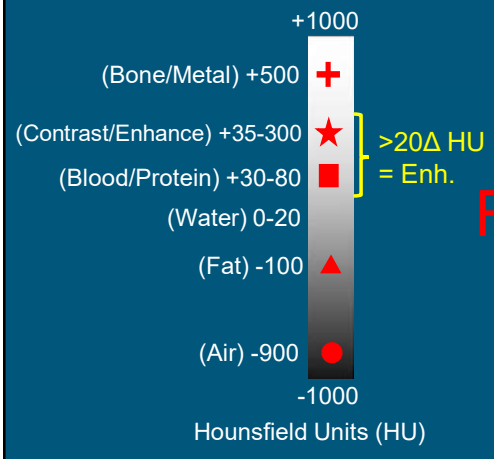
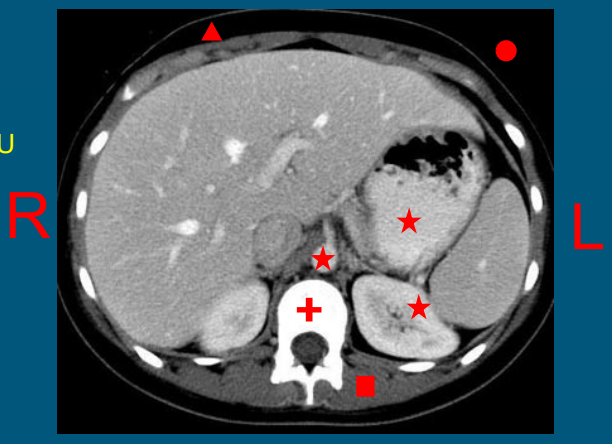
Interpreting CT





- Contrast? → Aorta (IV), Bowel (oral)
- Phase? → Kidney, Urothelium

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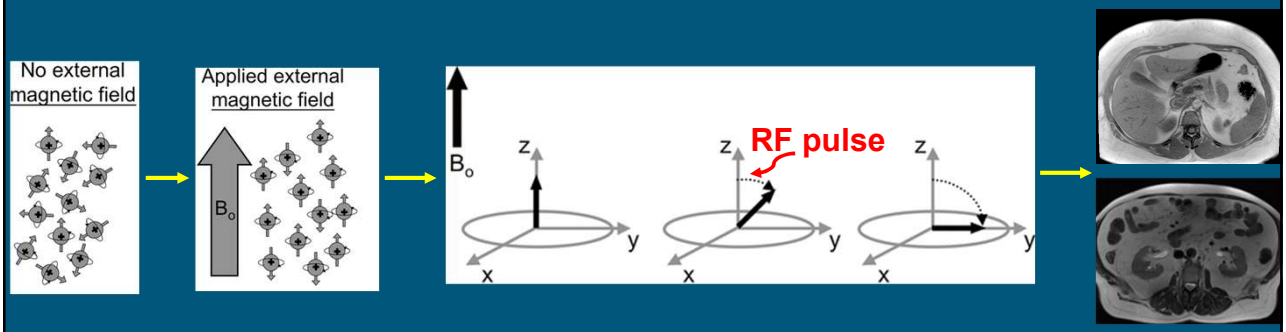
Magnetic Resonance (MRI)



- Image weighting: T1 vs. T2
- Modifications:
  - T1/2: Fat-saturation (removal)
  - T1: Contrast (enhancement, Δ15%), Chemical-shift (in/out of phase)
  - T2: Diffusion-weighting (cellularity)

Pooley, *Radiographics* 2005

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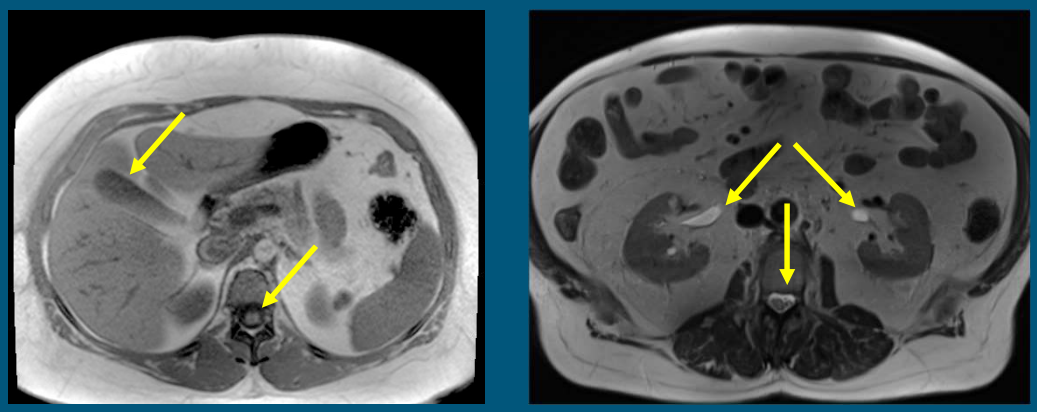
Image Weighting?



T1 (dark) **T2 (bright)**

Find the fluid!

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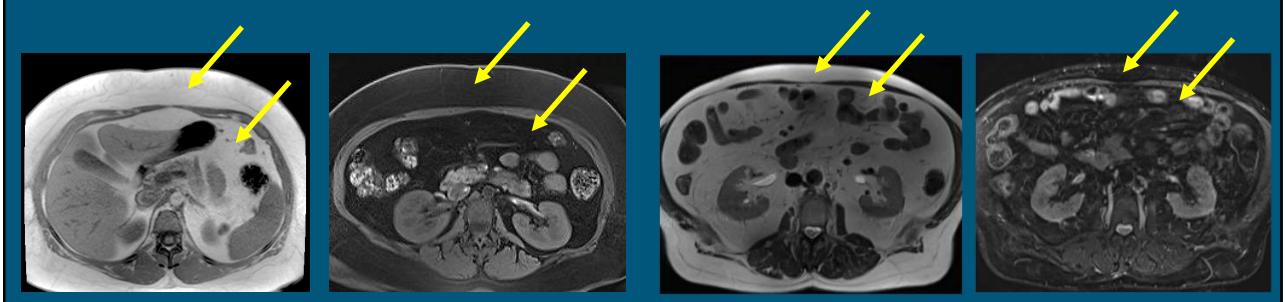
Fat Saturation (FS)?



T1 without FS **T1 with FS** **T2 without FS** **T2 with FS**

Find the fat!
(subQ, RP, peritoneum)

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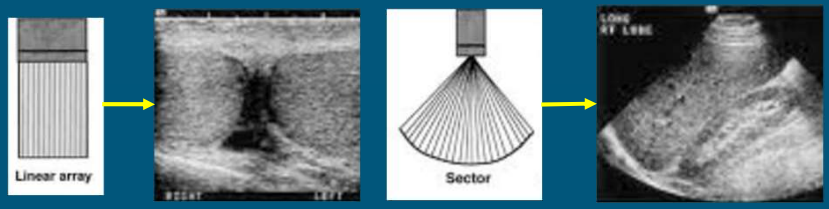
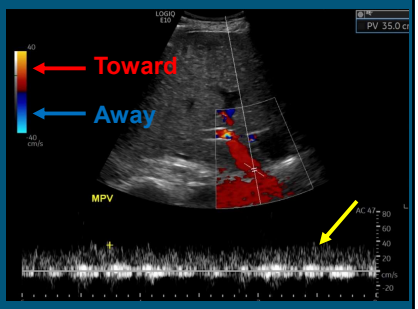
Ultrasound (US)





- **Transducer**: emits and receives sounds at a f range
  - **Higher** frequency (linear) – **higher** resolution, less penetration
  - **Lower** frequency (curved/sector) – **lower** resolution, deeper penetration
- **Echogenicity**
  - **Fluid:** max. penetration → **dark** (anechoic/hypoechoic, sonolucent), posterior enhancement
  - **Tissue/stones/bones:** min. penetration → **bright** (hyperechoic, sonodense), posterior shadowing
- **Doppler:** f change reflects speed of blood flow
  - **Color Doppler**: red and blue denote flow direction- not arterial/venous
  - **Spectral Doppler**: velocity

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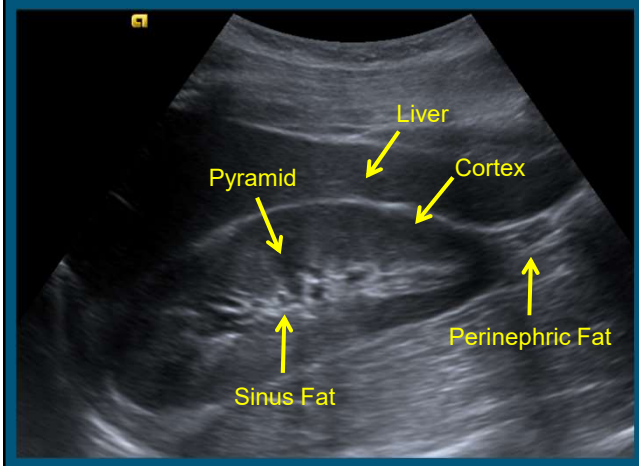
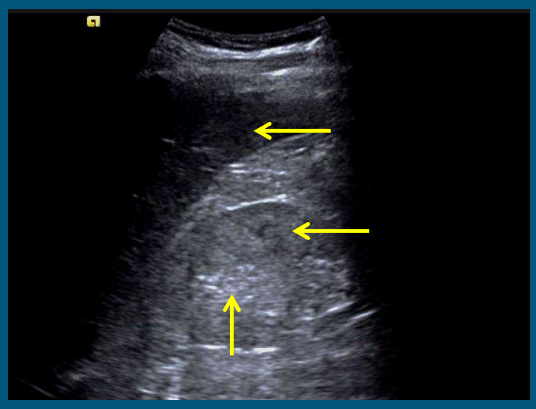
Interpreting US





"Medical Renal Disease"

- Nonspecific
- Brighter than liver, Difficult to separate parenchyma from sinus fat

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Iodinated Contrast (CT)

- Excretion: 90% kidneys, 10% hepatobiliary (higher if AKI/CKD)
- Filtration: **Nephrons** do it, tumors do not (no nephrons)
- Osmolarity:
  - High osmolar (old): $, higher reactions
  - Low osmolar (new/common): $$, lower reactions
  - Iso-osmolar (newest): $$$, lowest reactions/nephropathy

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Iodinated Contrast (CT)

- **Contrast Reactions**:
  - Mild: warmth, GI sx, few hives, itching
  - Moderate: diffuse hives, erythema
  - **Severe**:
    - **Anaphylaxis**: epinephrine (0.1-0.3 mL 1:1,000 SQ, 1-3 mL 1:10,000 IV)
    - **Vasovagal**: atropine (0.5-1 mg IV, up to 3 mg total)
- **Premedication** (prior severe reaction):
  - Routine: 50 mg PO prednisone 13-7-1h before + 50 mg diphenhydramine @1h
  - Urgent: IV steroids q4h before
- **Contrast-induced Nephropathy (CIN)**:
  - Definition: Contrast → AKI peaks @ 2d → resolves @ 2w
  - Avoid Contrast: AKI or CKD 4/5 (eGFR <30)
  - Prophylaxis: IV hydration before and after, mixed data on N-acetylcystine
  - Screening: if history of renal disease. DM = optional

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Gadolinium Contrast (MR)

- Same reactions and prep as iodinated contrast, but moderate and severe reactions are rare
- NO cross-reactivity with iodinated contrast, not nephrotoxic at clinical dose
- Nephrogenic Systemic Fibrosis (NSF):
  - **Linear (Group 1/3)** agents contraindicated in pts with renal failure (eGFR <30) due to NSF risk
  - Newer **macrocylic (Group 2)** agents are safer and approved for advanced CKD (eGFR < 30) → No Cr required
- Gadolinium Deposition
  - ACR: “Although there are no known adverse clinical consequences associated with gadolinium deposition in the brain, additional research is warranted”

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Voiding Cystourethrogram (VCUG)

- Bladder catheterized → water soluble contrast
- Image during filling → void (x1-3)
- Indications
  - Febrile UTI with abnormal US
  - Abnormal prenatal US
  - Incontinence or voiding dysfunction
  - Spina bifida or neurogenic bladder
  - “Genitogram”

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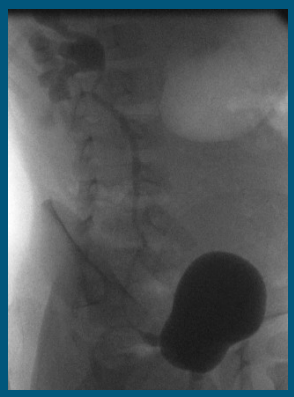
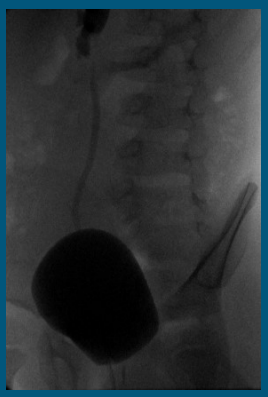
VCUG: Required Images

1. Early Filling





2. Obliques

3. AP Renal Beds

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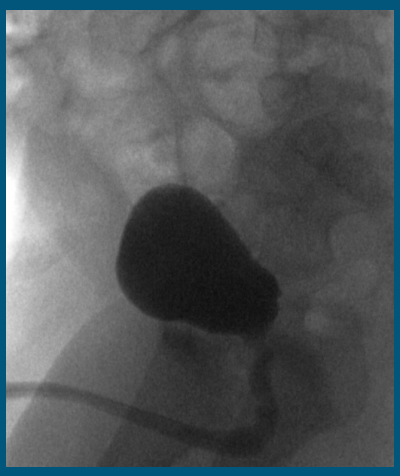
VCUG: Required Images



4. Voiding

5. Postvoid Renal Beds

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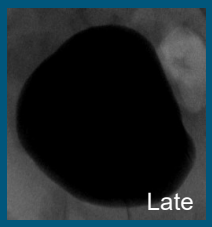
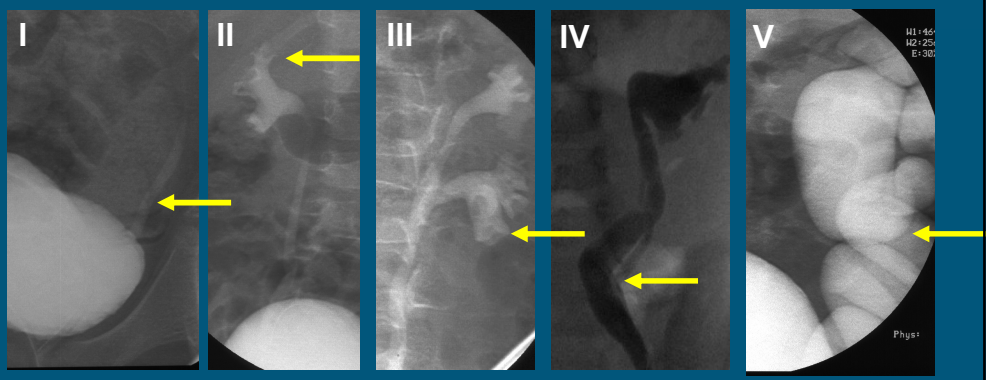
Common Abnormalities



Ureterocele



Vesicoureteral Reflux (VUR)

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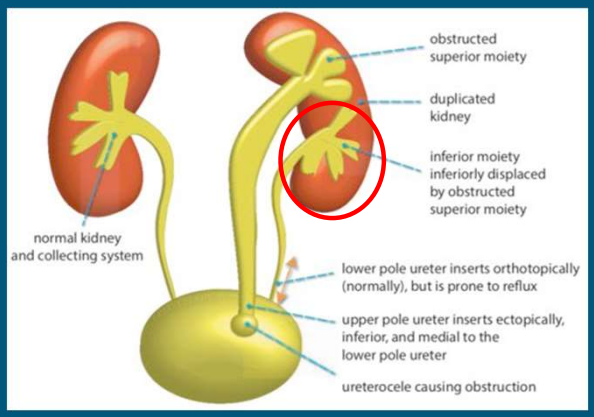
Weigert-Meyer Rule

Duplicated
Upper
Medial
Inferior



Upper
Ureterocele
Obstructs

Lower
Refluxes

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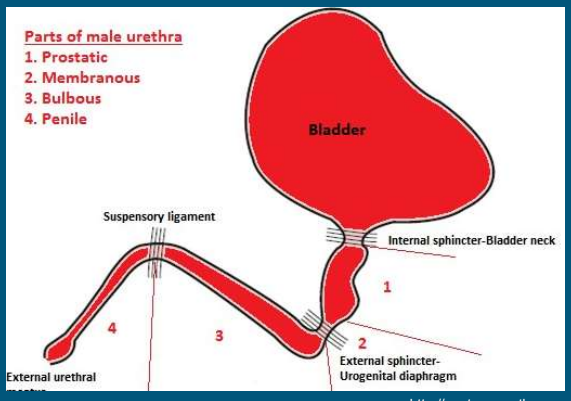
Normal Male Urethra



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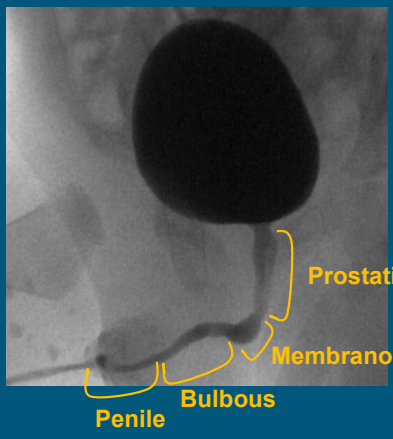

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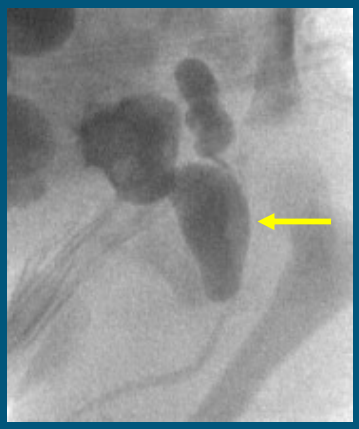
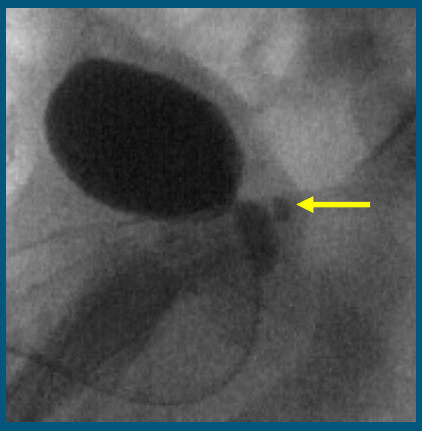
Common Abnormalities



Posterior Urethral Valves



Prostatic Utricle

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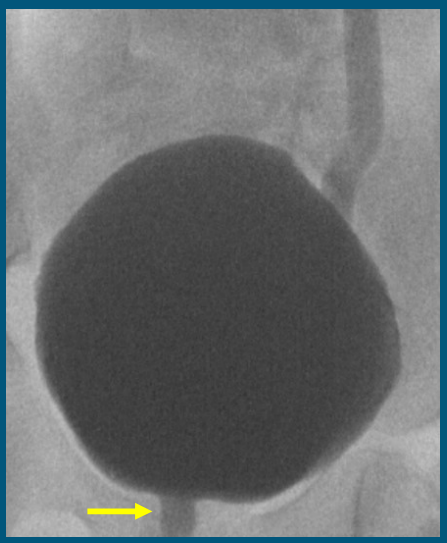
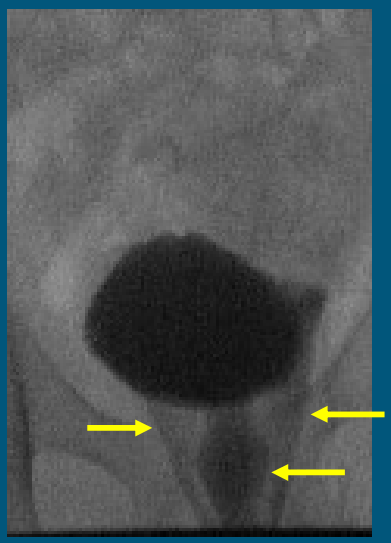
Normal Female Urethra





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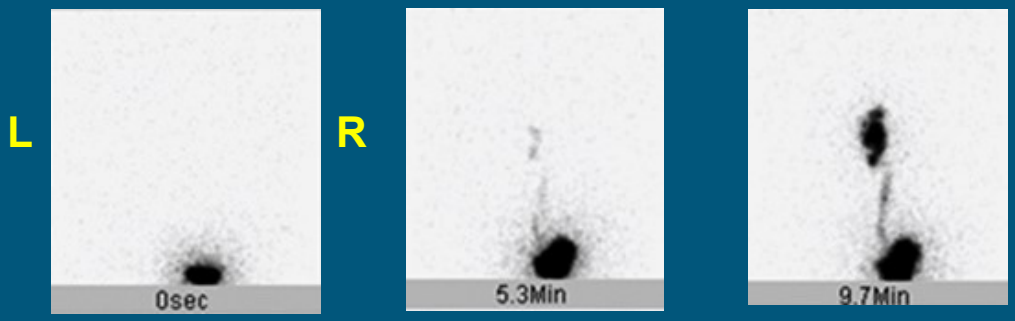
Nuclear Cystogram (RNC)

- Radiotracer via Foley → emission detected by camera
- Tracers: DTPA, pertechnetate, sulfur colloid
- Posterior view (~nephrostomy)



CH Kim 2015

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Nuclear Cystogram (RNC)

- Grading
  - 1: Ureter only
  - 2: Pelvicalyceal
  - 3: Pelvicalyceal + dilation/tortuosity
- Advantages (vs. VCUG)
  - Higher sensitivity (longer & more frequent acquisition)
  - 50-200x lower radiation dose
- Disadvantages (vs. VCUG)
  - Lower spatial/anatomic resolution
  - Fewer grades (3 vs. 5)
  - ?Availability

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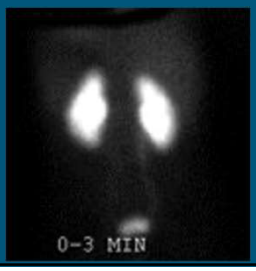
Nuclear Renogram

- IV Radioactive tracer → emission detected by camera
- Tracers:
  - Filtered (function, drainage): **MAG-3**, DTPA
  - Excreted (tubular function): **MAG-3**, hippuran
  - Cortical (scar, mass vs. pseudotumor): DMSA, glucoheptonate
- Posterior view (~nephrostomy)

L 

R

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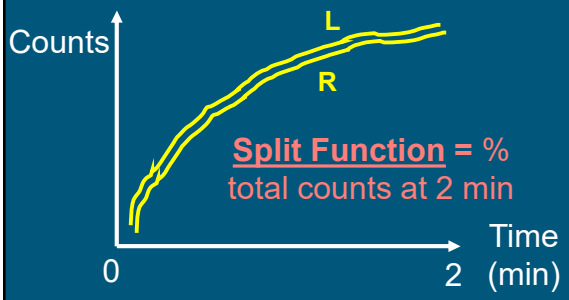
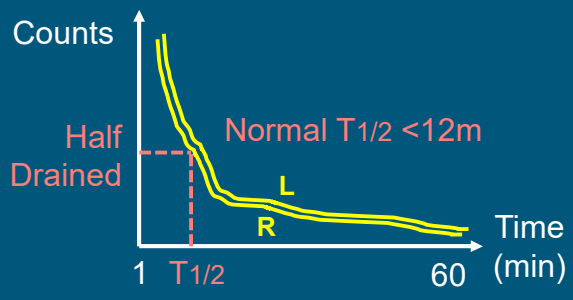
Nuclear Renogram

Early (Flow/Perfusion)



Late (Function/Drainage)



Lasix administered if obstruction suspected

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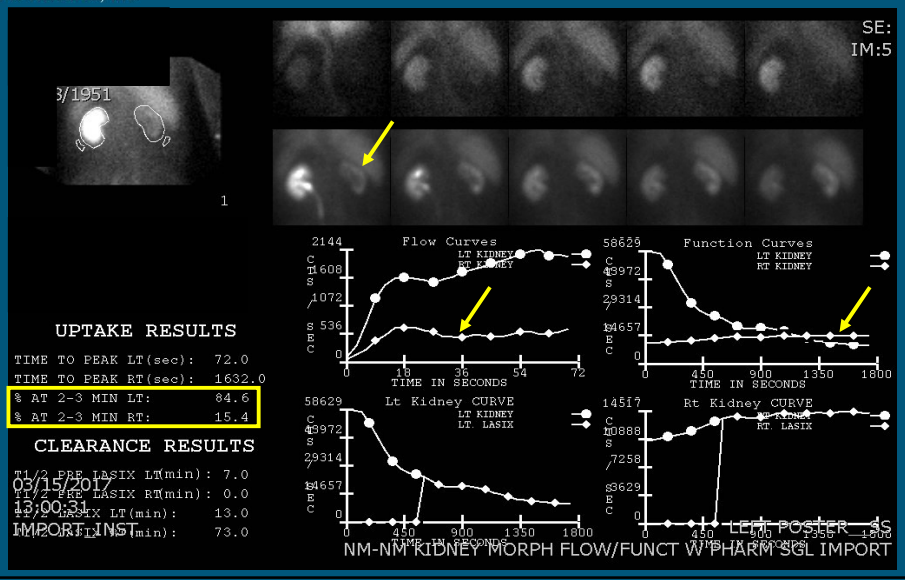
Asymmetric Function



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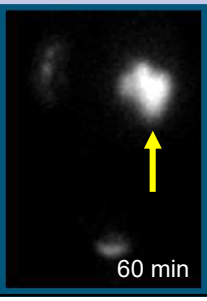
UPJ Obstruction

Parameters	Left	Right
Split Function (%)	65.2	34.8
Kidney Counts (cpm)	238462	127061
Kidney Depth (cm)	6.329	6.371
Renal Retention	0.355	
Time of Max (min)	4.501	30.5
Time of ½ Max (min)	13.8	



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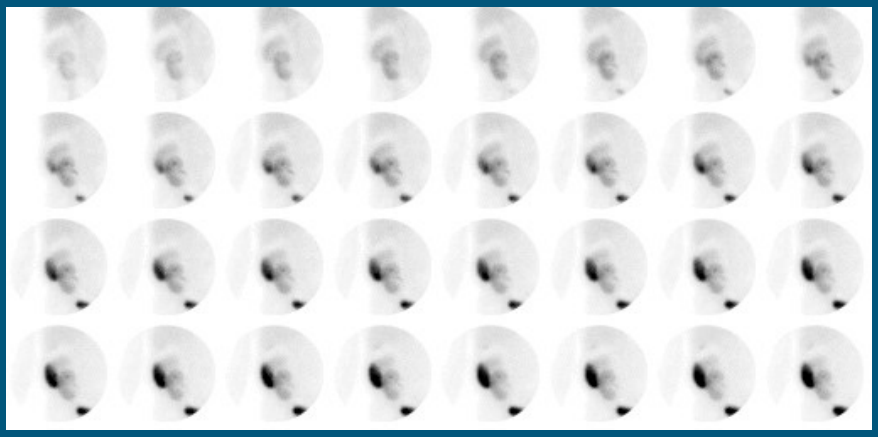
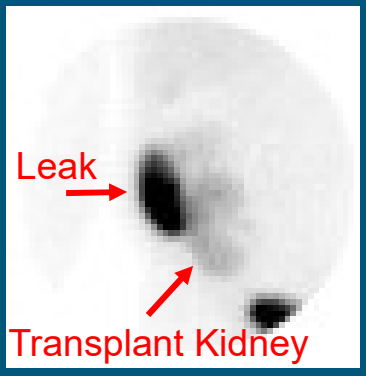
Urine Leak





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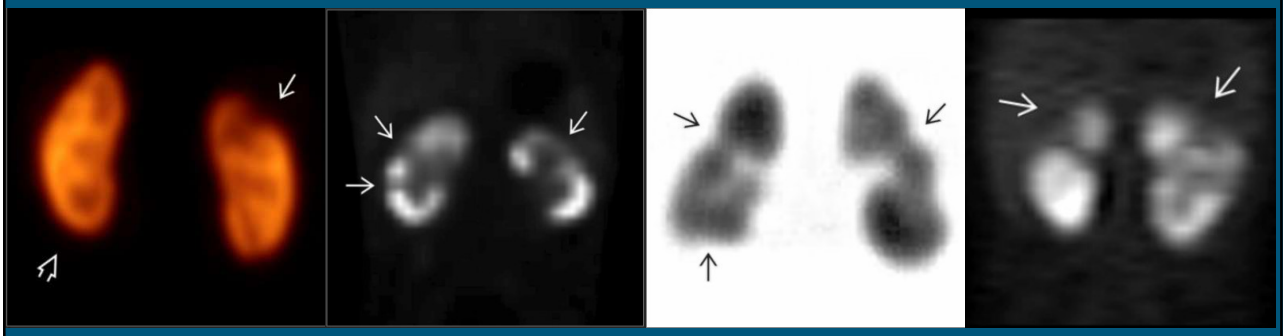
DMSA: Scar/Nephritis



Outline

- Radiation & Fluoroscopy
- Basics of CT, MRI, US, & VCUG
- Nuclear Medicine
- **Renal Masses & Stones**
- Prostate MRI
- Adrenal Imaging
- Scrotal Imaging
- Retroperitoneal Tumors

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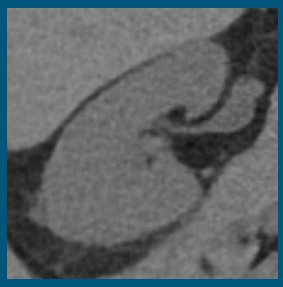
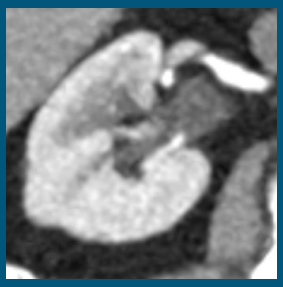
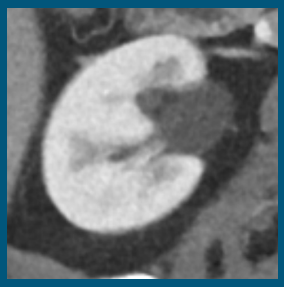
CT/MR Contrast Phases



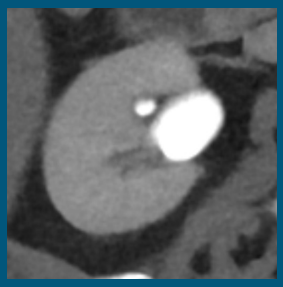
Noncontrast
- Baseline density (CT) or intensity (MR)
- Stones (CT)



Corticomedullary (20-45s)
- Arterial pathology
- Masses
- Pyelonephritis/Infarct



Nephrogram (80-120s)
- Venous pathology
- Masses
- Pyelonephritis/Infarct



Urogram (5m+)
- Urothelial lesions
- Leaks

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RENAL MASSES

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CYSTIC RENAL MASSES

Cyst with <25% enhancing component

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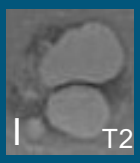

Bosniak Class (Malignant %)	Follow-Up
I (0%) -Simple fluid (-10-20 HU, T2 hyper, anechoic) -Thin wall, no septa/calcs, nonenhancing	None

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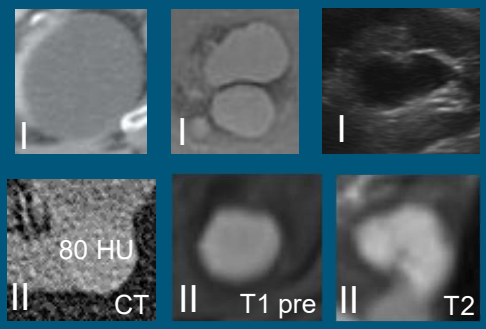

Bosniak Class (Malignant %)	Follow-Up
I (0%) -Simple fluid (-10-20 HU, T2 hyper, anechoic) -Thin wall, no septa/calcs, nonenhancing	None
II (<1%) -Pre/Post: >20 HU, no enhancement -Pre-contrast: >70 HU, T1 hyper (blood) -Few (1-3) thin (≤2mm) septa, thin wall, calcs	None

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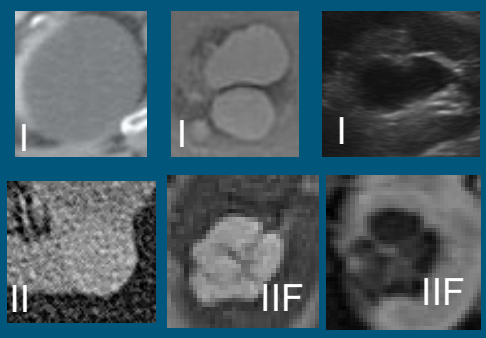

Bosniak Class (Malignant %)	Follow-Up
I (0%) -Simple fluid (-10-20 HU, T2 hyper, anechoic) -Thin wall, no septa/calcs, nonenhancing	None
II (<1%) -Pre/Post: >20 HU, no enhancement -Pre-contrast: >70 HU, T1 hyper (blood) -Few (1-3) thin (≤2mm) septa, thin wall, calcs	None
IIF (0-38%) -Many (4+) smooth septa -Minimally thickened (3mm) wall or septa -Heterogenous T1 (?bleeding tumor)	Imaging @ 6m, 12m, 2-5y

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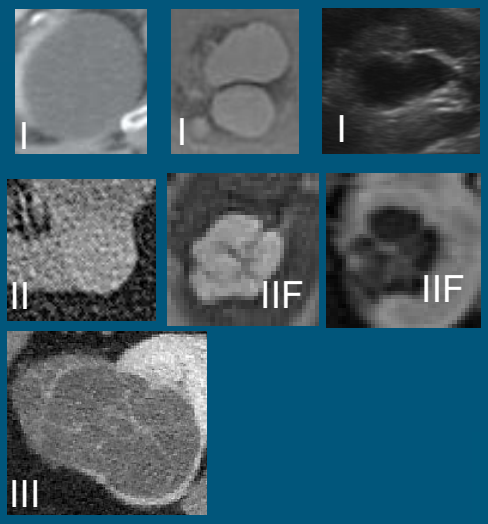

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IIF (0-38%) -Many (4+) smooth septa -Minimally thickened (3mm) wall or septa -Heterogenous T1 (?bleeding tumor)	Imaging @ 6m, 12m, 2-5y
III (50%, higher if prior RCC) Thick (4mm+) or irregular wall or septa	**Urology Consult**

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Cystic Nephroma (Bosniak 3)

- FKA Multilocular Cystic Nephroma
- **Benign**
- Boys < 2 years, adult women > 30 years (8F:1M)
- Imaging:
  - Well-defined, multicystic, enhancing thick septa, can prolapse into the collecting system

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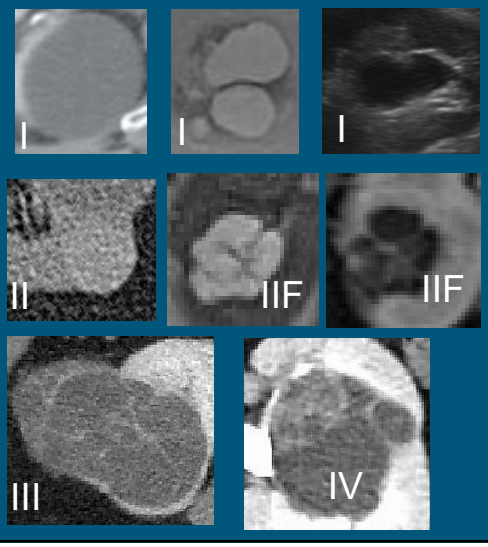

Bosniak Class (Malignant %)	Follow-Up
I (0%) -Simple fluid (-10-20 HU, T2 hyper, anechoic) -Thin wall, no septa/calcs, nonenhancing	None
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IIF (0-38%) -Many (4+) smooth septa -Minimally thickened (3mm) wall or septa -Heterogenous T1 (?bleeding tumor)	Imaging @ 6m, 12m, 2-5y
III (50%, higher if prior RCC) Thick (4mm+) or irregular wall or septa	**Urology Consult**
IV (90%) 4mm+ convex nodule	

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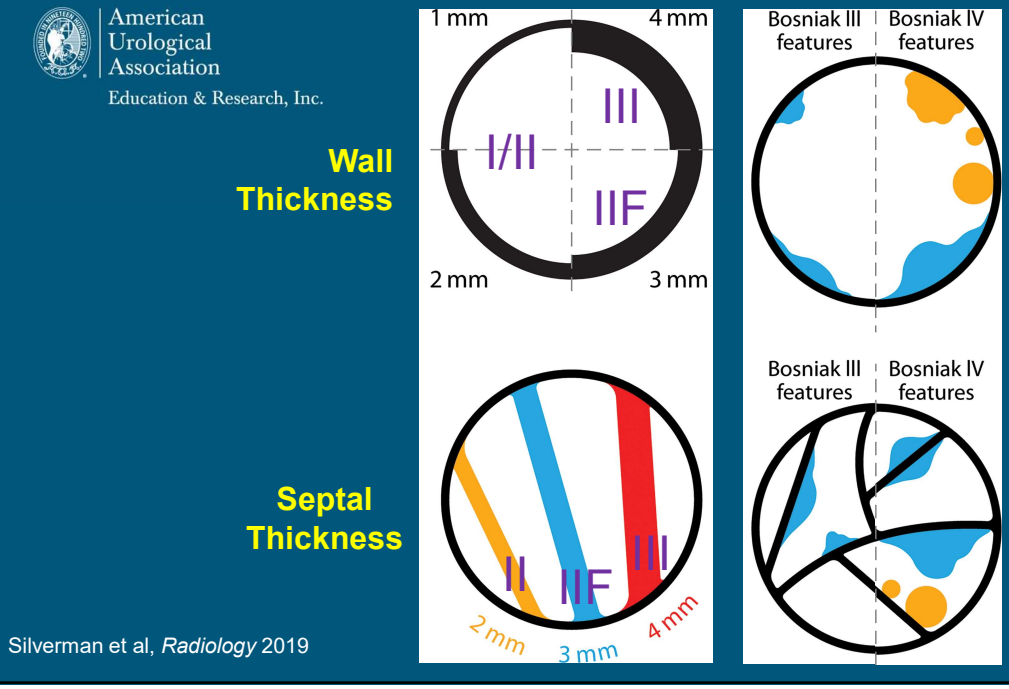

Silverman et al, *Radiology* 2019

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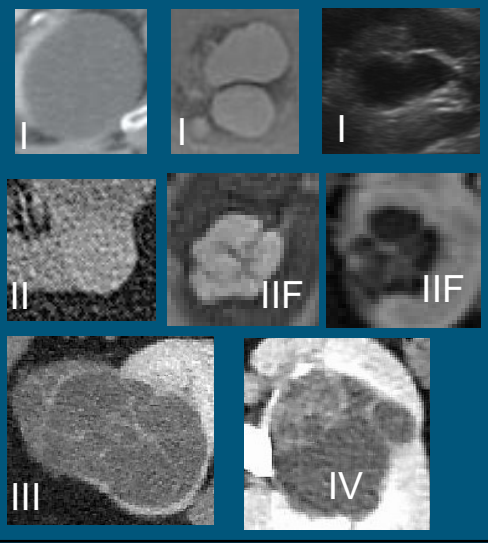

https://bosniak-calculator.herokuapp.com/

Bosniak Class (Malignant %)	Follow-Up
I (0%) -Simple fluid (-10-20 HU, T2 hyper, anechoic) -Thin wall, no septa/calcs, nonenhancing	None
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III (50%, higher if prior RCC) Thick (4mm+) or irregular wall or septa	**Urology Consult**
IV (90%) 4mm+ convex nodule	

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Cystic Diseases

Acquired Cystic Kidney Disease

- HD
- Bilateral **atrophy** + cysts
- ↑ risk CA

Autosomal Dominant Polycystic Kidney Disease (ADPKD)

- Hereditary → CKD
- Bilateral **enlargement** + cysts
- ↑ risk CA, berry aneurysms

Yu et al, Lancet Oncol 2016

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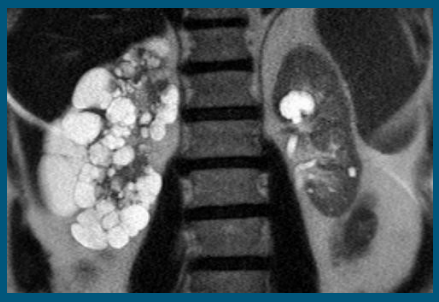
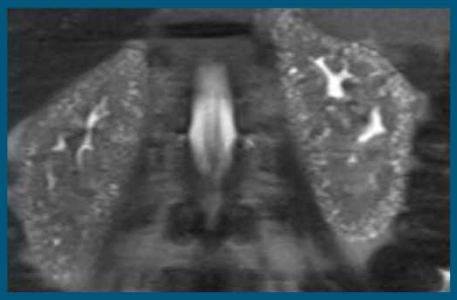
Cystic Diseases

Localized Cystic Renal Disease



- Incidental or hematuria, pain
- Unilateral, separated by normal parenchyma
- No ↑ CKD or CA

Lithium-Induced Renal Disease



- Tubule injury → CKD
- Bilateral, innumerable microcysts cortex/medulla
- No ↑ CA

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SOLID RENAL MASSES

25-100% enhancing component

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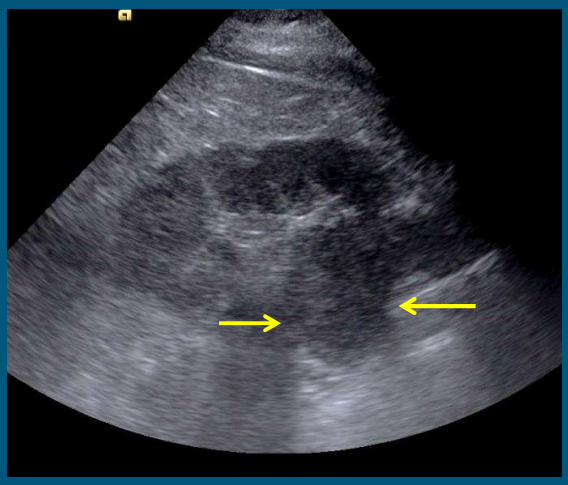
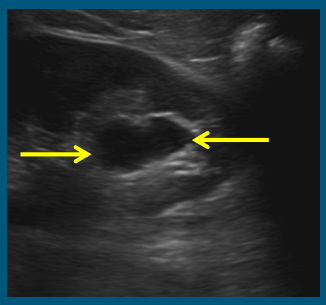
Solid Mass on US





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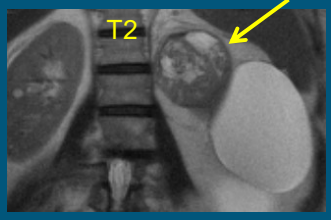
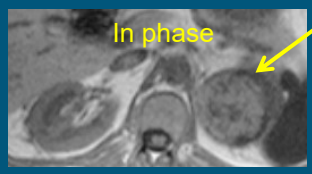
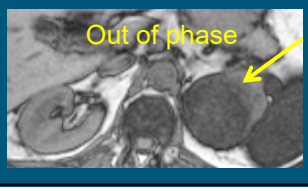
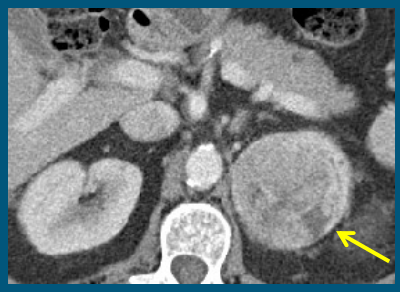
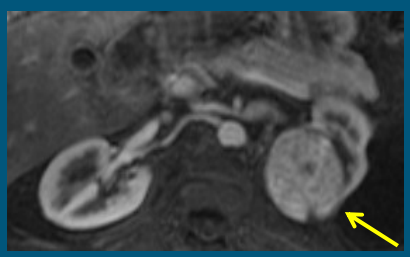
RCC: Clear Cell











- Most common RCC subtype
- Imaging:
  - Heterogenous
  - Hypervascular (≥ cortex)
  - T2 bright (> cortex)
  - Contains lipid (“clear” cell)

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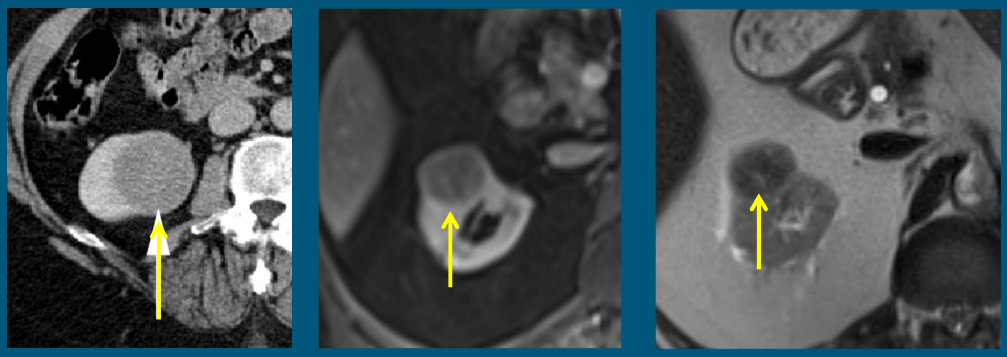
RCC: Papillary



- 2nd most common, better prognosis, can be multifocal
- Imaging
  - Homogenous, hypovascular (< cortex)
  - T2 hypointense (< cortex)

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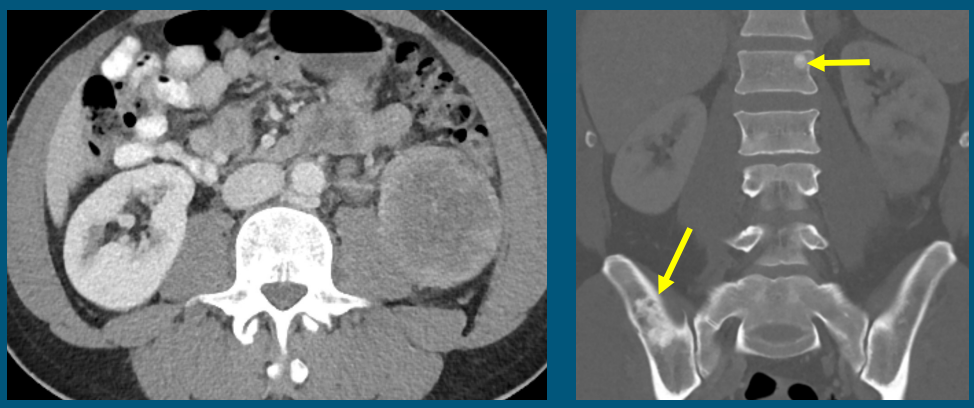
RCC: Medullary



- Often large and/or metastatic at presentation
- Sickle cell **trait**

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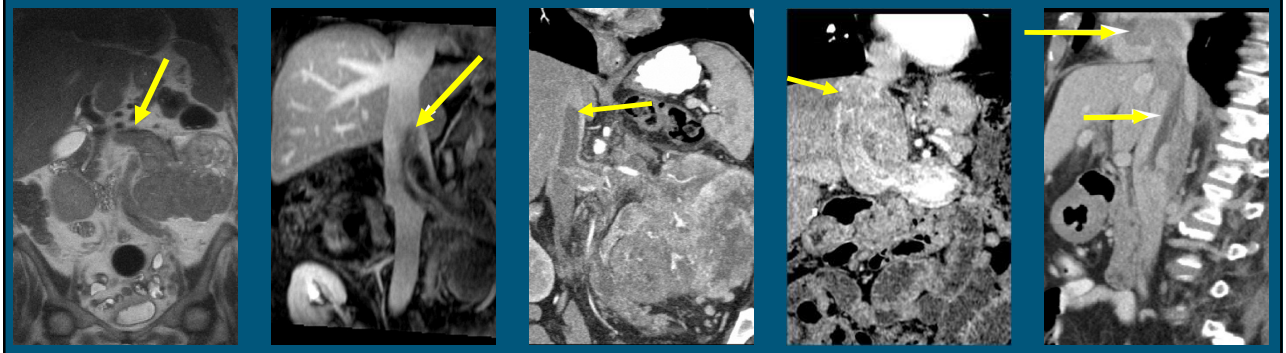
IVC Tumor Thrombus



Level 0: Renal vein only

Level 1: Up to 2 cm in IVC

Level 2: >2 cm in IVC, not to hepatic veins

Level 3: Hepatic veins, not diaphragm

Level 4: Above diaphragm, RA

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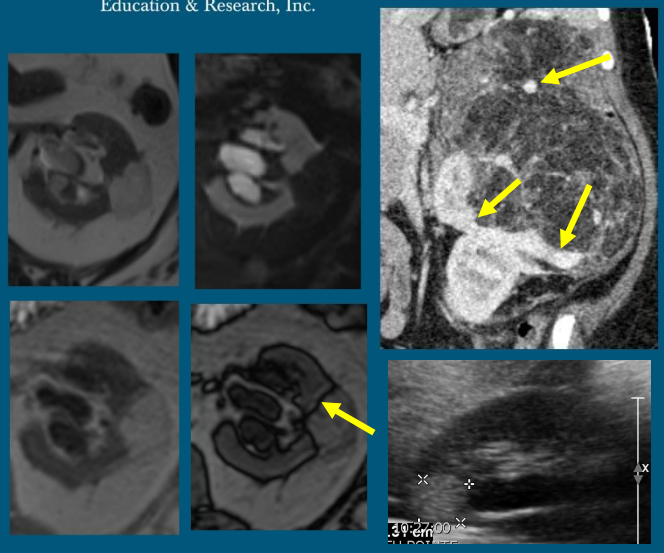
Angiomyolipoma



- Benign hamartoma of vessels, muscle, and fat. Female predominance, TS
- Imaging:
  - CT: Fat (<-10HU) + soft tissue
    - Cortical notch, draining vein, aneurysms, NO calcifications (RCC)
  - US: hyperechoic to sinus fat
  - MR: follows subQ fat on all sequences, india ink with kidney (fat/water interface)

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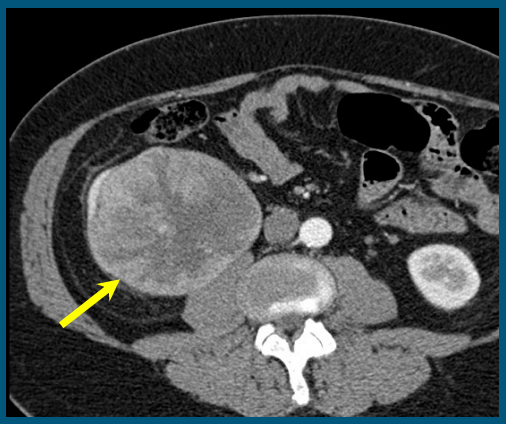
Oncocytoma & Fat-Poor AML

?spoke wheel

?central scar

?segmental enhancement inversion



Cannot prospectively differentiate from RCC on imaging

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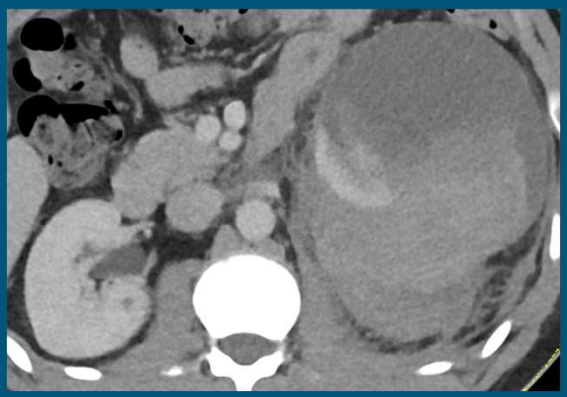
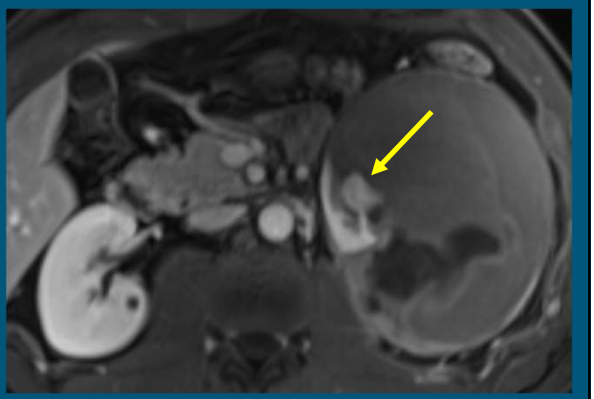
Renal/Perirenal Hemorrhage





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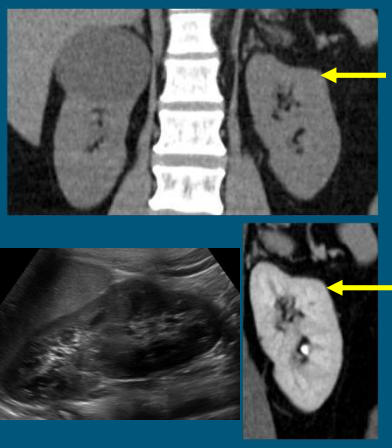
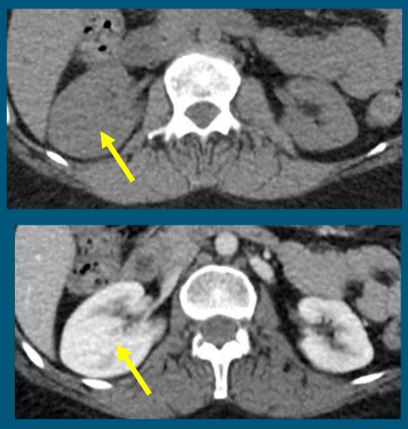
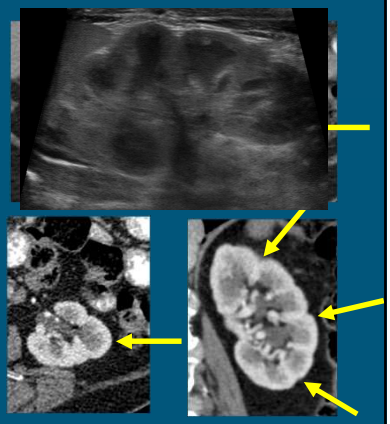
Renal Pseudotumors



Dromedary Hump
- Left-sided, focal
- Splenic impression



Hypertrophied Column of Bertin
- Either side, focal
- Incomplete fusion of lobules



Persistent Fetal Lobulation
- Either side, diffuse
- Incomplete fusion of interlobular folds

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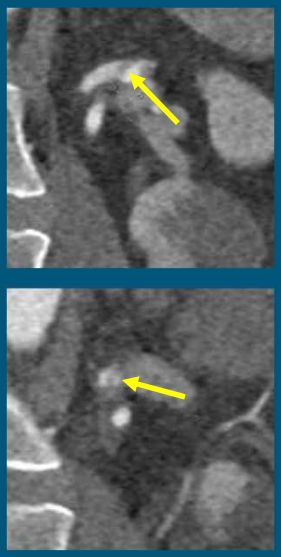
Renal Infarct

- Imaging: wedge-shaped defect(s) +/- cortical rim +/- dissection, occlusion
- Causes:
  - Vasculitis: medium, large
  - Emboli: infection, A-fib



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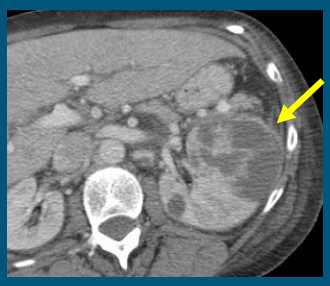
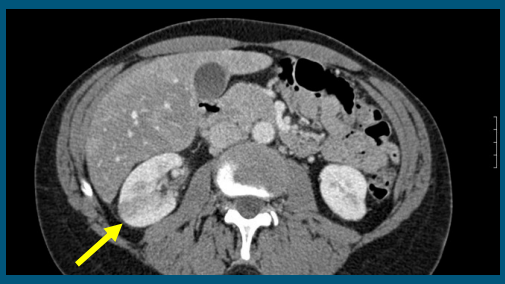
Pyelonephritis

- Fever, flank pain & pyuria
- "Striated" nephrogram
- Mimics infiltrating tumor, infarct
- Consider follow-up imaging





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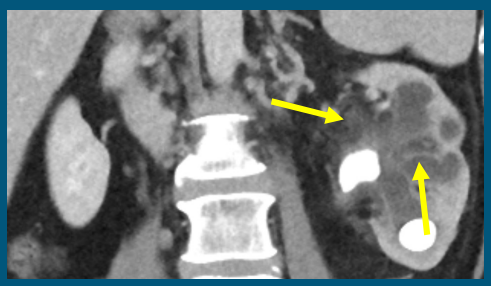
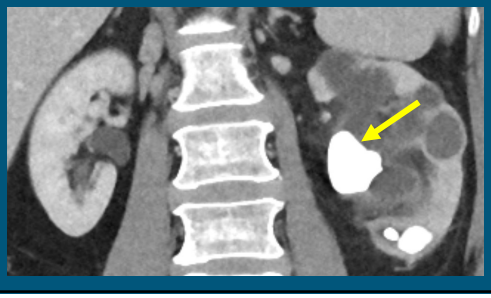
Xanthogranulomatous Pyelonephritis

- Etiology: staghorn calculus → chronic obstruction → nonfunctional replaced with granulomas
- Complications: infection, CA (UC, SCC)
- ?NM scan (assess function)





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STONE DISEASE

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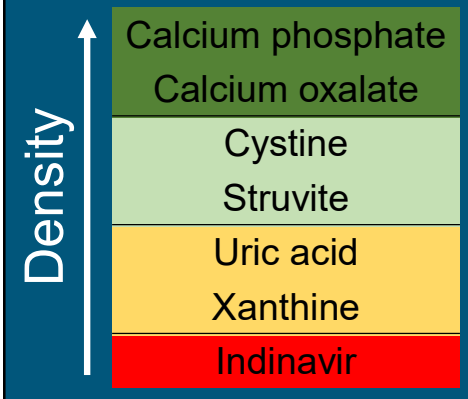
Urolithiasis



	XR	CT
Calcium phosphate / Calcium oxalate	✓	✓
Cystine / Struvite	?	✓
Uric acid / Xanthine	X	✓
Indinavir	X	X

Factoids

- Modality:

CT > US/XR >>> MR

- Follow-up (ALARA)
  - XR if visible
  - US for hydro
  - "Low-dose" CT
    - 1 mSv (10x less!)
    - 4 mm+ stones
    - **Only if BMI <30**

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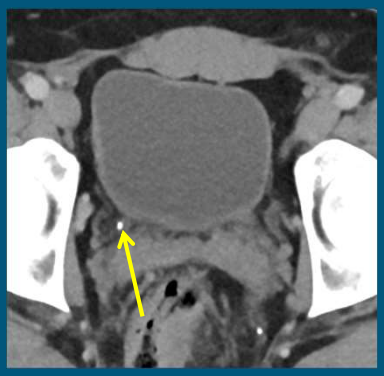
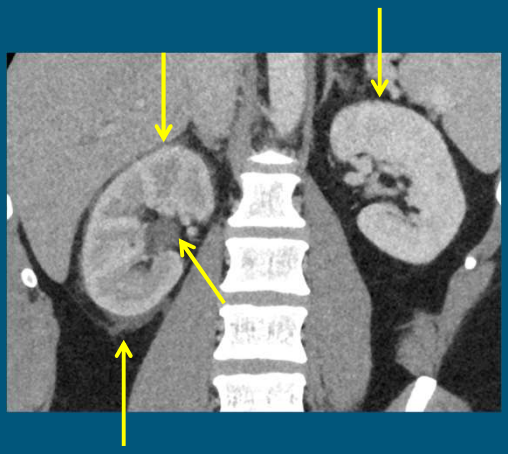
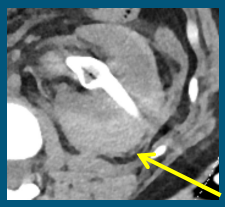
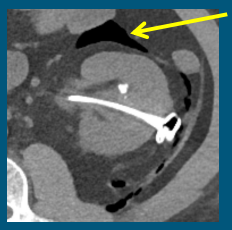
Stone Disease on CT









Nephrolithotomy

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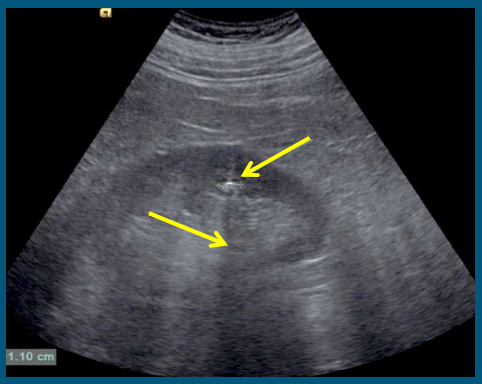
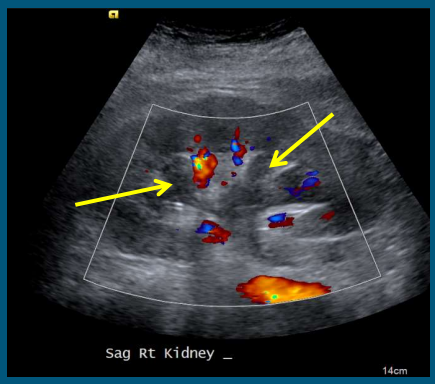
Stone Disease on US



Shadowing renal stone



Hydronephrosis
Branching **communicating** hilar fluid

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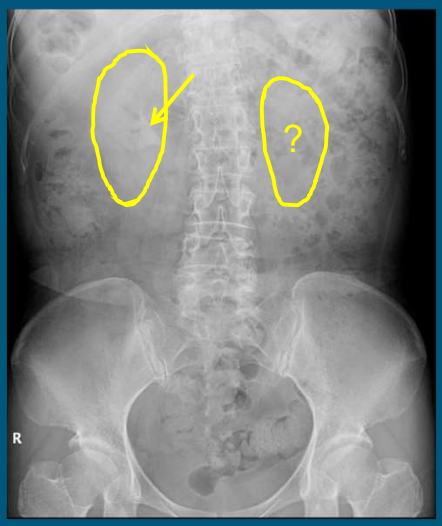
Stone Disease on XR



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Medullary Nephrocalcinosis

- Imaging: Medullary pyramid calcs +/- stones
- Causes: **HAM HOP** (**H**yperparathyroidism, [renal tubular] **A**cidosis Type 1, **M**edullary sponge kidney, **H**ypercalcemia/hypervitaminosis D, **O**xalosis, **P**apillary necrosis)

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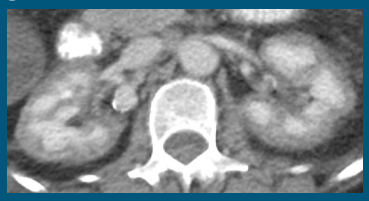
Cortical Nephrocalcinosis

- **Imaging**: calcs outlining thinned kidneys
- **Causes**: severe cortical injury
  - Cortical necrosis



  - Chronic glomerulonephritis
  - Chronic pyelonephritis
  - Transplant rejection

Outline

- Radiation & Fluoroscopy
- Basics of CT, MRI, US, & VCUG
- Nuclear Medicine
- Renal Masses & Stones
- **Prostate MRI**
- Adrenal Imaging
- Scrotal Imaging
- Retroperitoneal Tumors

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Prostate MRI: Overview

- Indications
  - Suspicion: biopsy naïve/negative, guide TRUS biopsy
  - Follow-up: low-grade disease
  - Staging: seminal vesicles, neurovascular bundles, nodes, bladder, rectum
- Sequences (“multiparametric”)
  - Diffusion-weighted imaging (DWI): tumors bright (cellularity)
  - Apparent diffusion coefficient (ADC): tumors dark
  - T2-weighted: tumors dark
  - Dynamic contrast enhancement (DCE): PZ tumors enhance early
  - T1-weighted: hemorrhage bright (tumors not)- wait 6-8 weeks post-biopsy

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Prostate MRI: Anatomy

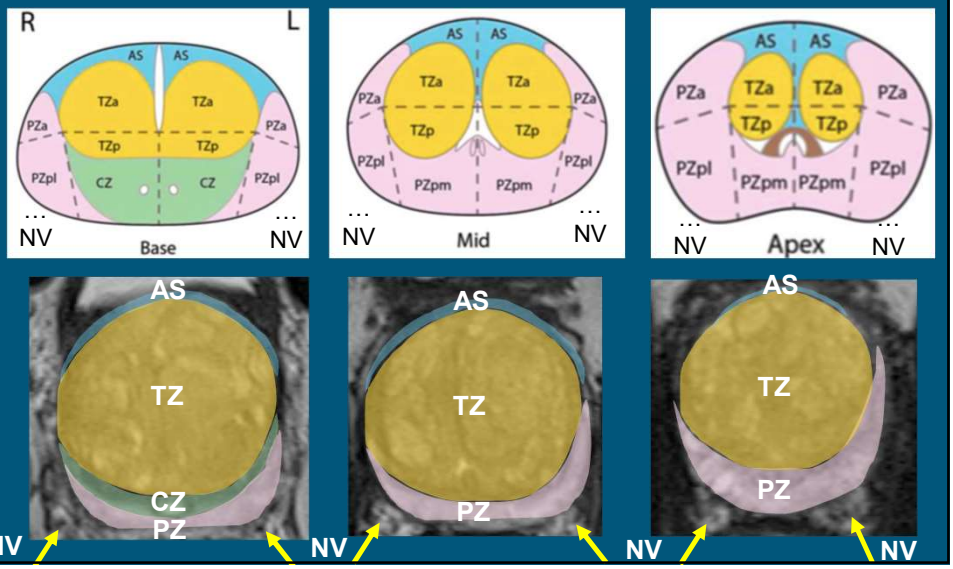
PZ = Peripheral Zone

CZ = Central Zone

TZ = Transition Zone

AS = Anterior Fibromuscular Stroma

NV = Neurovascular Bundle



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Prostate MRI: PI-RADS v2.1

- 5 scores for clinically significant prostate CA
  - PR1: highly unlikely
  - PR2: unlikely
  - PR3: equivocal
  - PR4: likely
  - PR5: highly likely
- PZ/CZ: DWI/ADC
  - If PR3, early DCE can bump to PR4
- TZ/AFMS: T2
  - If PR2 or 3, DWI/ADC can bump to PR3 or 4, respectively
- 1.5 cm suspicious lesion, or extra-prostatic extension → **PR5**

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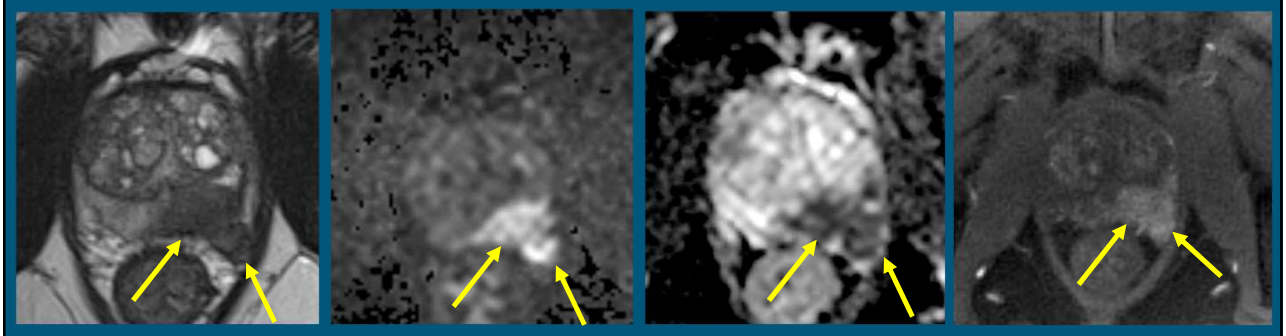
Peripheral/Central Zone Cancer



T2 DWI ADC DCE

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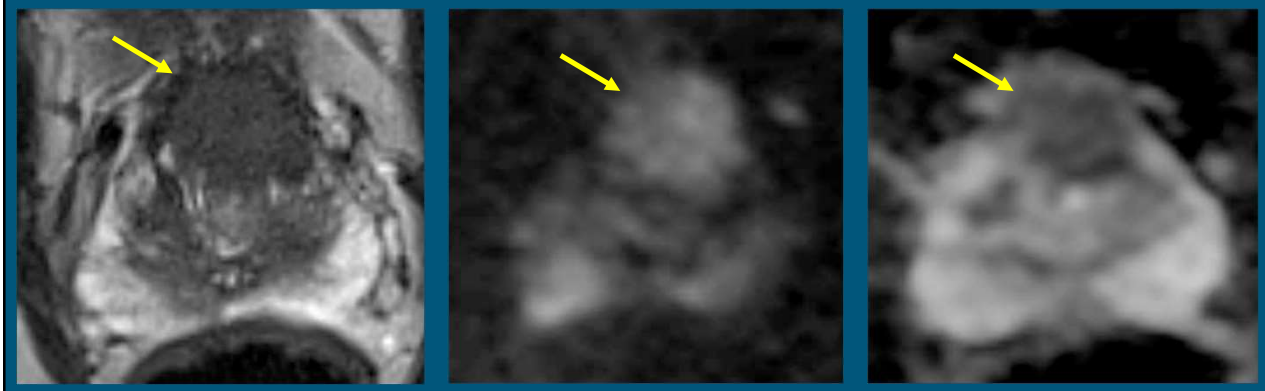
Transition Zone/AFMS Cancer



T2 DWI ADC

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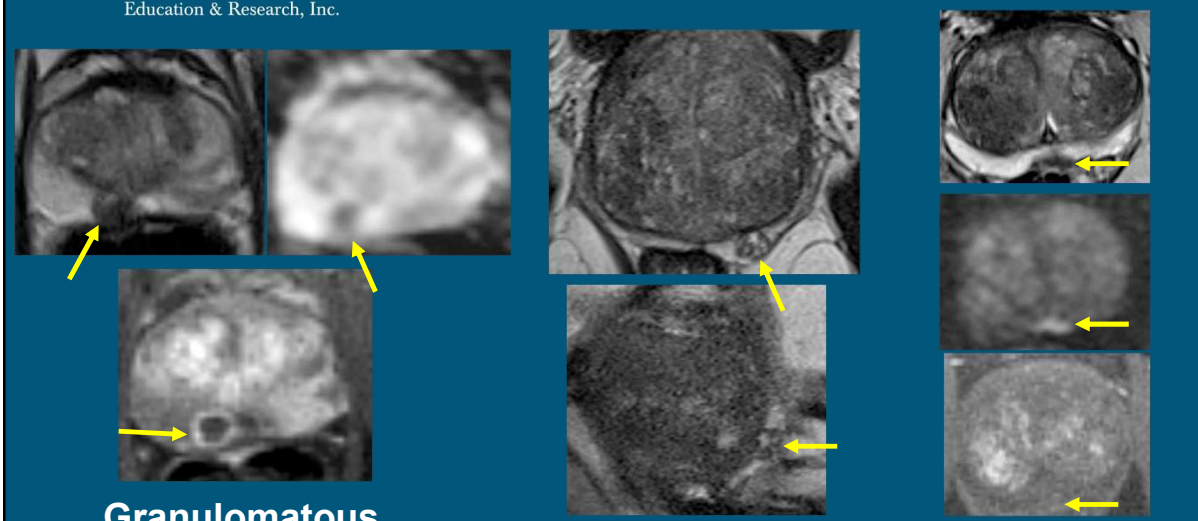
Prostate MRI: Pitfalls



Granulomatous prostatitis

Extruded BPH

"Pseudolesion"

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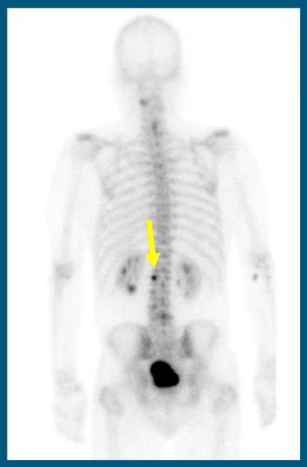
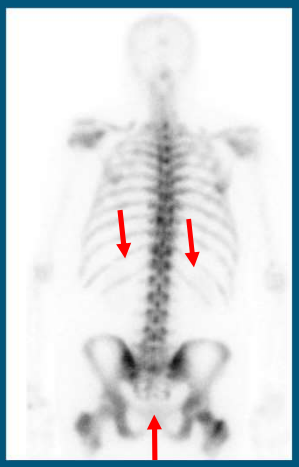
Prostate Metastases



NM Bone Scan:
Technetium-99m MDP



"Superscan"

Outline

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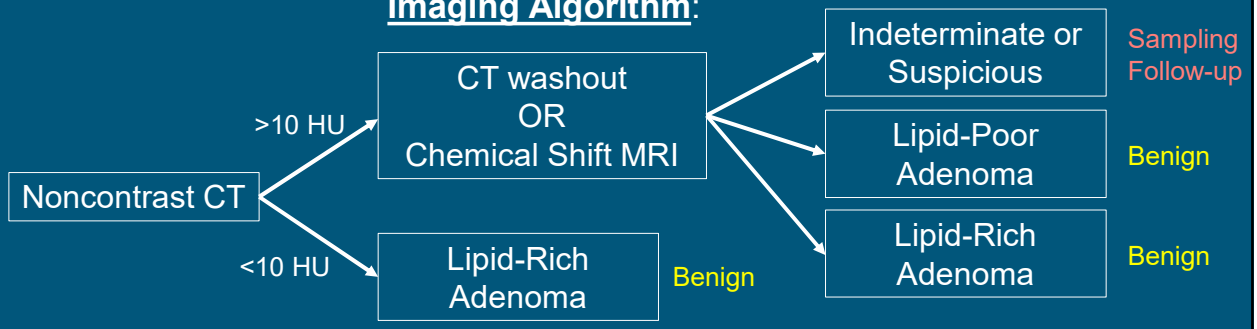
Adrenal Nodules

- Most are adenomas (15% functional)
- Most adenomas (70%) have lipid due to precursor hormones
- Most enhance early and washout due to vascularity

Imaging Algorithm:



If >4 cm or growing >3 mm year, needs tissue regardless of imaging!

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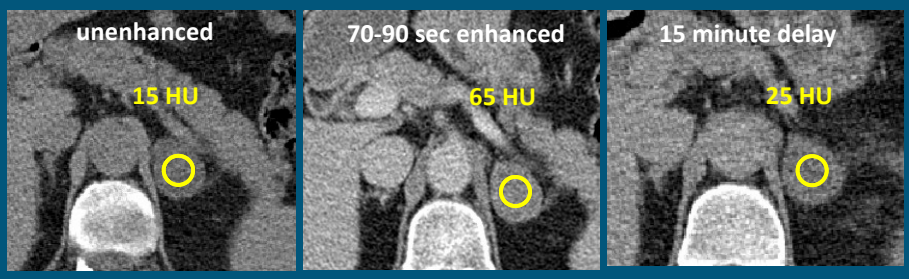
Adrenal Washout



- Unenhanced CT: **15HU – proceed with washout study**
- **Absolute washout**: (enhanced - delay) / (enhanced - unenhanced) * 100
  (65-25) / (65-15) = **80%** **(>60% = lipid-poor adenoma)**
- **Relative washout**: (enhanced - delay) / enhanced * 100
  (65-25)/65 = **62%** **(>40% = lipid-poor adenoma)**
  ***Real life tip: go to the web - Search "adrenal washout calculator"!*
- **Caveats**: hypervascular mets or pheo (>120 HU)

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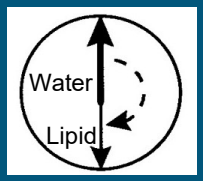
Chemical Shift MRI



In phase:
Signal from H atoms in water and lipid **SUM**

Out of phase:
Signal from H atoms in water and **SUBTRACT**

Dropout/loss of signal indicates lipid = lipid-rich adenoma
(no washout criteria on MRI)

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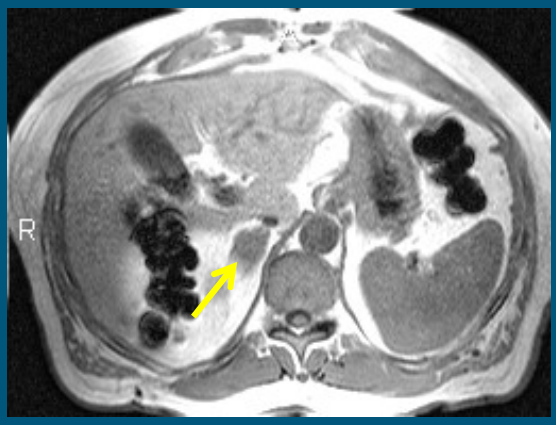
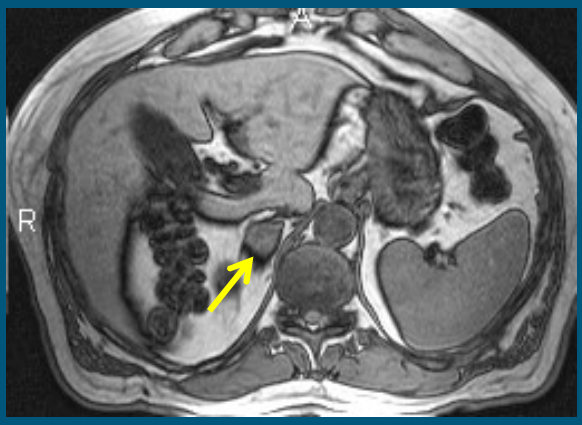
History of Lung Cancer





In phase

Out of phase

No loss of signal → suspicious for metastasis

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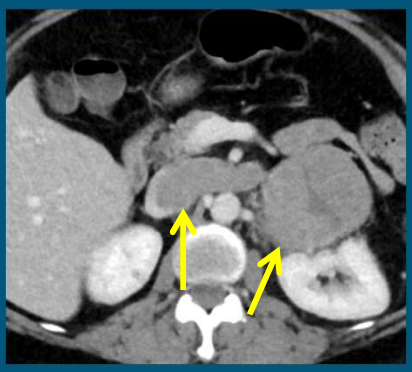
Adrenal Cortical Carcinoma



- Large (>4 cm), heterogenous +/- calcifications, hemorrhage, venous invasion, metastases

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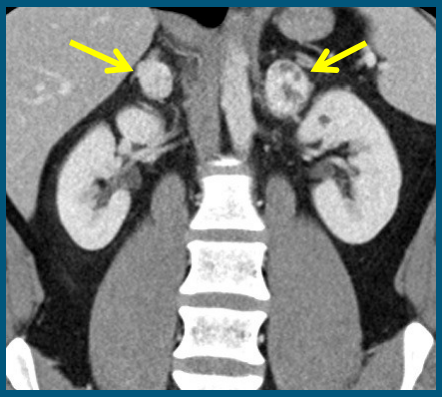
Pheochromocytoma

- Can be extra-adrenal, bilateral, malignant, pediatric, familial
- Hypertension, elevated serum catecholamines, urinary metanephrines
- CT: >10 HU precontrast (unless cystic), >120 HU post-contrast
- MRI: T2 ”light bulb” bright, avid enhancement
- Nuclear Medicine: MIBG, pentetreotide, octreotide, **DOTATATE**



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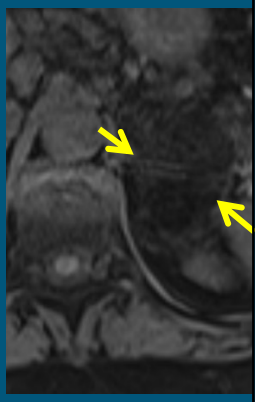
Myelolipoma

- Contains marrow (**myelo-**) and lipid (**-lipoma**)
- Other sites: Liver, mediastinum, presacral
- CT: fat (≤ -10 HU) with variable soft tissue
- MR: T1/T2 bright, fat suppression, soft tissue
- Can hemorrhage (if large)

T1



T1 FS

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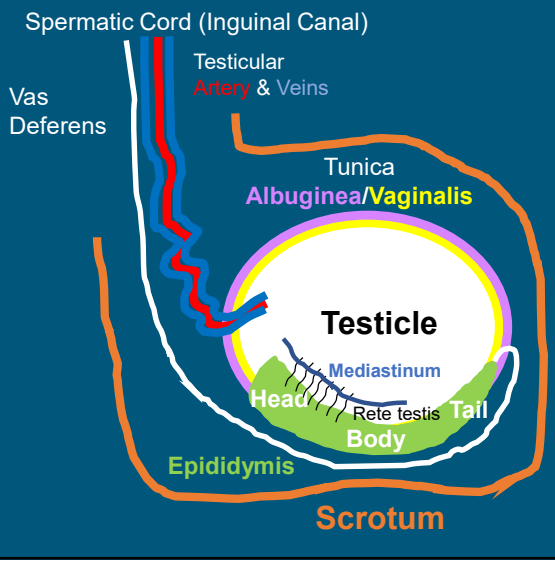
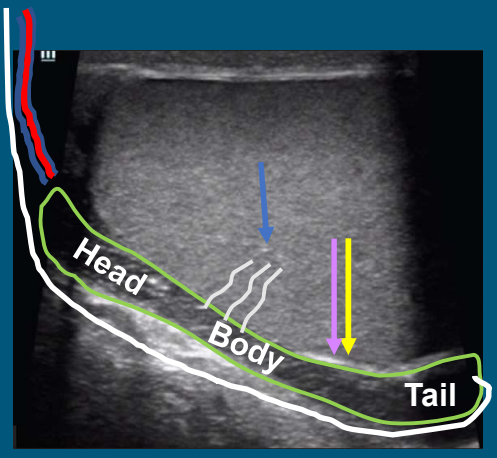
Scrotal Anatomy





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Testicular Neoplasms

- Germ cell tumor (GCT)
  - Seminomatous GCT
  - Non-Seminoma GCT
- Sex-Cord Stromal
  - Leydig
  - Sertoli
- Lymphoma

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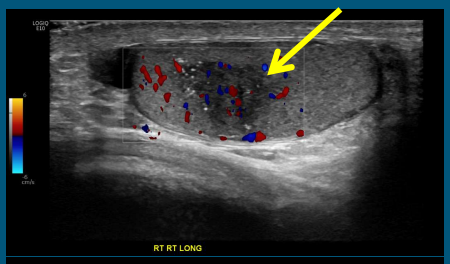
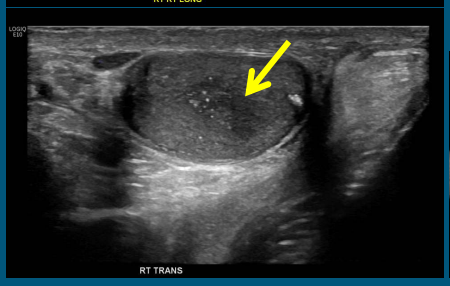
Seminomatous GCT

- Imaging:
  - Homogeneous hypoechoic mass + blood flow
  - Microcalcs (not shadowing)
  - Spread to RP>pelvic LN
- Risk factors: cryptorchidism, Klinefelter, injury
- Biomarker: LDH





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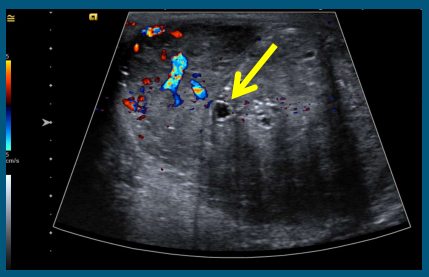
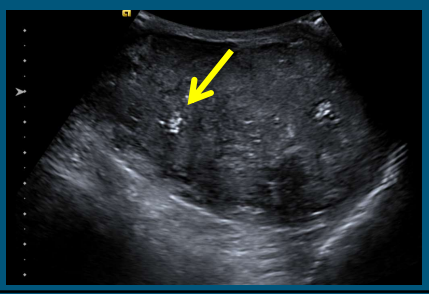
Non-Seminomatous GCT

- Same risk factors
- Imaging:
  - Heterogenous
  - Cystic change
  - MACROcalcs (shadowing)
- Types: Embryonal, Teratoma, Yolk Sac, Choriocarcinoma, Mixed
- Biomarkers: HCG, AFP





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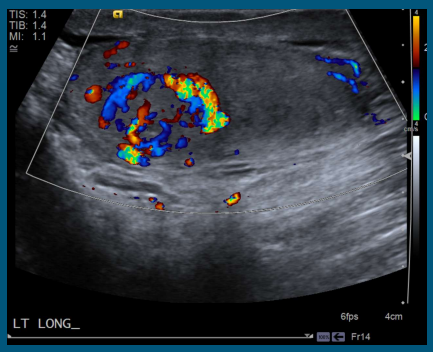
Sertoli-Leydig Tumor



- Imaging: hypoechoic mass
- Usually benign but cannot differentiate from GCT
- Biomarker: androgen
- Can present with precocious puberty and gynecomastia

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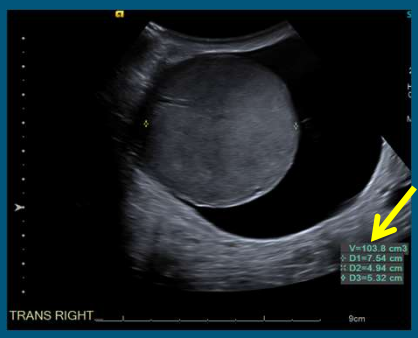
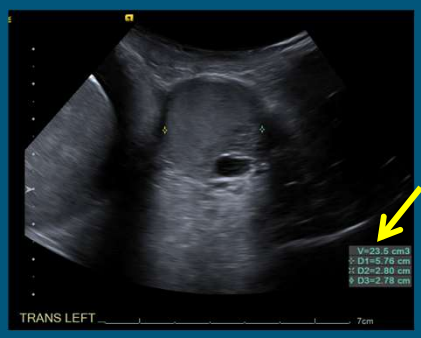
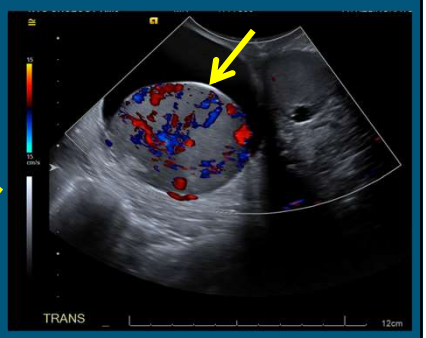
Testicular Lymphoma







- Imaging: replacement of testicle by **homogenous** hypoechoic tissue
- Most common testicular malignancy in men >60 yo (they can still get seminoma)
- Usually Non-Hodgkin B-Cell
- Can be disease reservoir (blood-testis barrier)

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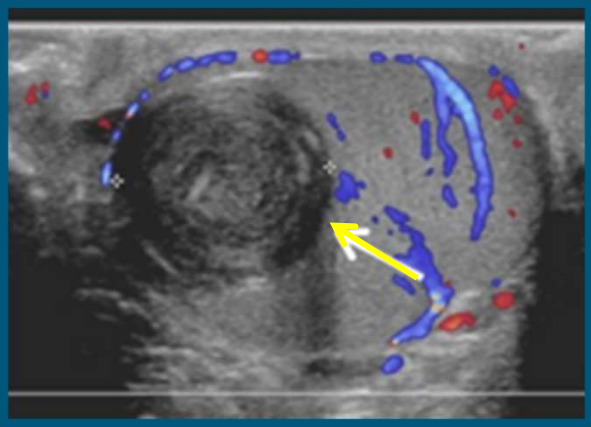
Epidermoid Cyst

- Benign tumors, 1-2% of testis masses, ectodermal tissue
- Imaging:
  - **"Onion skin" or "whorled" appearance**
  - Non-vascular, well-defined
- Treatment - enucleation



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Tubular Ectasia

- Spermatozoa containing cysts
- Often bilateral and more common in >55yo
- Can also be in the epididymis
- Associated with spermatoceles

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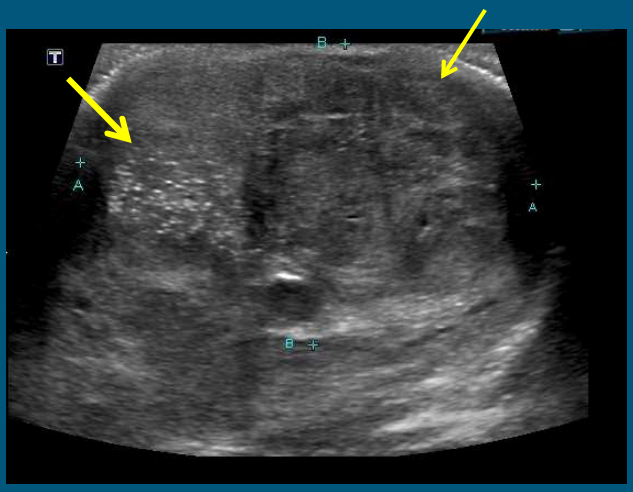
Microlithiasis



- Imaging: >5 punctate echogenic foci per field
- AUA: "Testicular microlithiasis **in the absence of solid mass and risk factors** for developing a GCT does not confer an increased risk of malignant neoplasm and does not require further evaluation. (Moderate Recommendation; Evidence Level: Grade C)"

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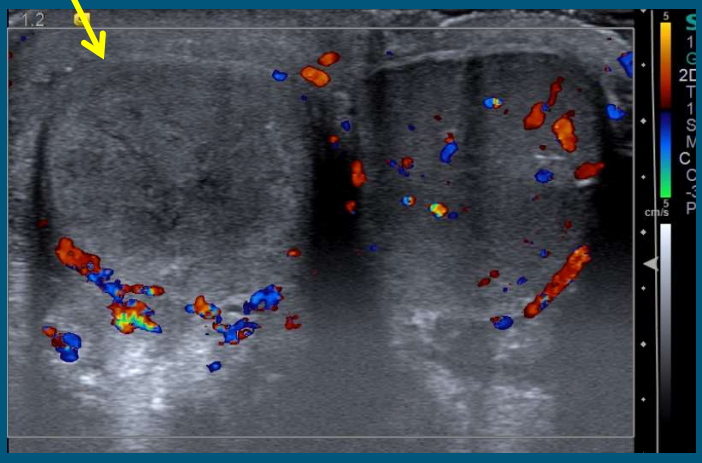
Testicular Torsion

- Imaging: enlarged, hypoechoic, heterogenous testicle with reduced flow +/- twisting of pedicle
- Types: classified based on tunica vaginalis
  - Extravaginal (10%)- neonates
  - Intravaginal (90%)- older kids/adults



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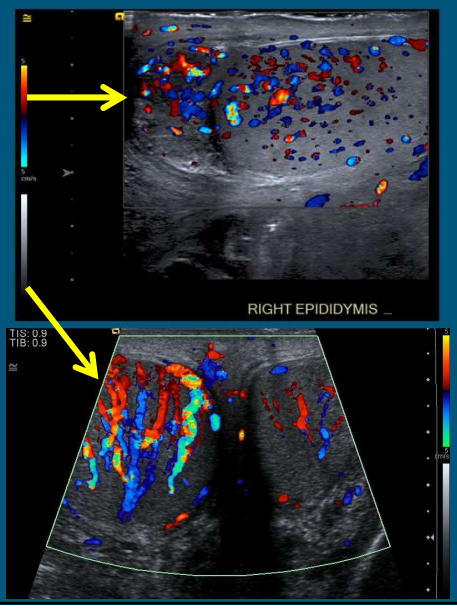
Epididymoorchitis

- Imaging:
  - Epi thickened > 1 cm
  - Heterogenous
  - Increased color Doppler signal
- Etiology: UTI → epi tail → epi head → testis
- Causes:
  - Most common: GC
  - Older men: E. coli
  - Isolated orchitis: Mumps
  - Smoldering infxn: TB
- Complications: infarct, abscess



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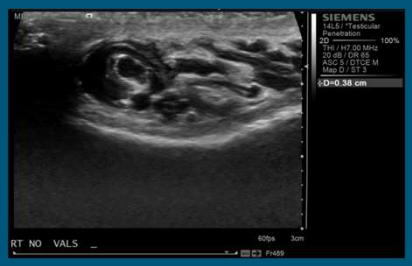
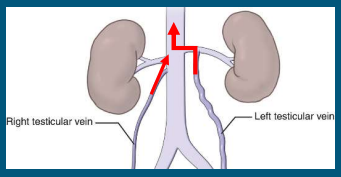
Varicocele



- Dilated spermatic veins
- Presentation: Asymptomatic, infertility, “bag of worms”
- Imaging: ≥3 mm veins
- Left >>> Right (gonadal vein insertion)
  - Isolated right varicocele → CT



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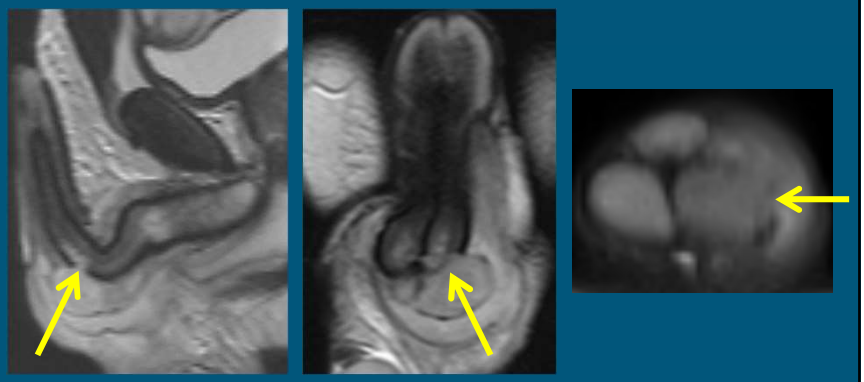
Penile Fracture

- Most commonly secondary to sexual intercourse
- Clinical: audible crack, loss of erection
- Usually affects distal 2/3rds
- MRI: tunica (T1/T2 hypointense) disruption, can assess urethral integrity



Outline

- Radiation & Fluoroscopy
- Basics of CT, MRI, US, & VCUG
- Nuclear Medicine
- Renal Masses & Stones
- Prostate MRI
- Adrenal Imaging
- Scrotal Imaging
- **Retroperitoneal Tumors**

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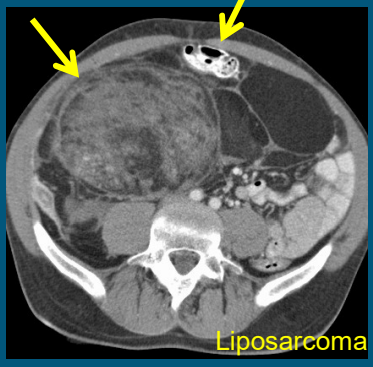
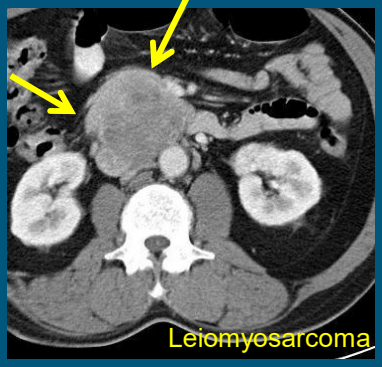
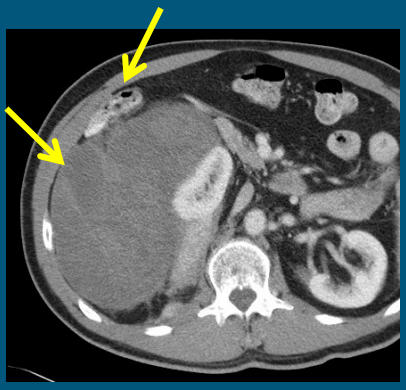
Sarcoma







- Most common 1º RP malignancy
- Liposarcoma **>** Leiomyosarcoma > many others
- Imaging: Large, heterogenous +/- fat +/- vascular invasion

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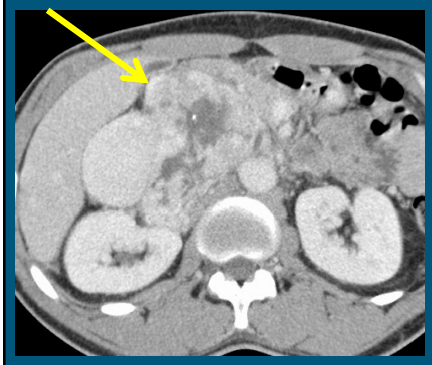
Paraganglioma



- "Extra-adrenal pheochromocytoma"
- Hyperenhancing
- Anywhere from L2-S1

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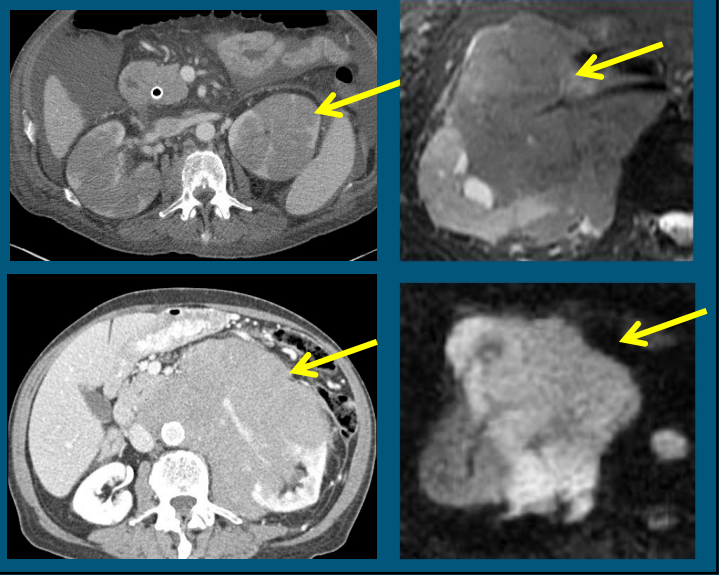
Renal/Perirenal Lymphoma

- Secondary NHL > primary
- Renal prevalence: 10% (imaging), 30-60% (autopsy)
- Imaging
  - Renal: bilateral masses
  - Perirenal: encasing soft tissue, no hydro
  - MRI: T2 hypointense, diffusion restricting
  - Lymphadenopathy, splenomegaly



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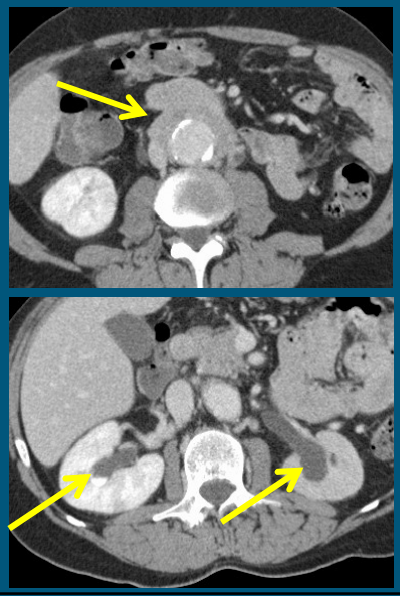
Retroperitoneal Fibrosis

- Mimics lymphoma
- Soft tissue rind around aorta, IVC, ureters
- Usually spares perirenal/suprarenal spaces
- **Hydronephrosis, tethers ureters medially**



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Question #1

A fluoroscopy operator will **increase** administered radiation dose by:

A. Collimating the image field of view
B. Reducing patient distance from the detector
C. Enabling image magnification
D. Using last image hold
E. Reducing fluoroscopy pulse rate

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Question #2

A relative contraindication to low-dose CT for urinary stone follow-up is:

A. Cystine stone composition
B. Stone size of 6 mm
C. Hydronephrosis
D. Morbid obesity
E. Age under 18 years

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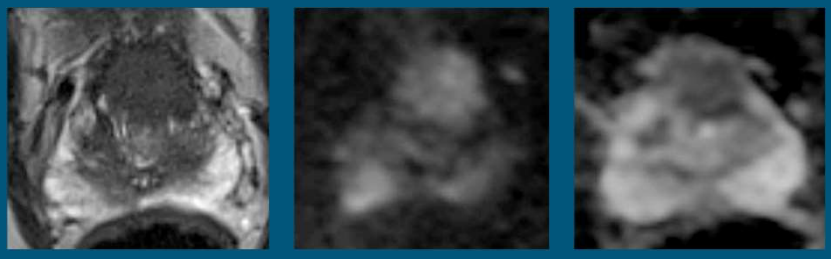
Question #3



According to the Prostate Imaging Reporting and Data System (PI-RADS), the MRI feature most indicative of prostate cancer in the location shown on these images is:

A. High signal on ADC
B. Brisk contrast enhancement
C. Circumscribed heterogenous nodule
D. High signal on T1
E. Low signal on T2

THANK YOU!

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