New Slides

Radiological Anatomy & Investigations of Urinary System

Lecture 7

Objectives

- To know the different types of modalities used in imaging the urinary tract
- To know the anatomic location and sizes of the structures of the urinary tract
- To identify the kidneys, ureters, urinary bladder and urethra on different imaging modalities

Color Index: -Main text -Males slides -Female slides -Dr's notes -Important -Golden note -Extra

Team Leaders :

Rahaf Almotairi

Mayssam Aljaloud

Sultan Alshehri

Done by :

Raneem Alwatban

Saud Al Taleb

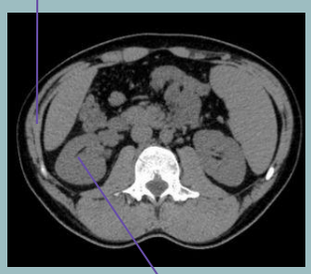
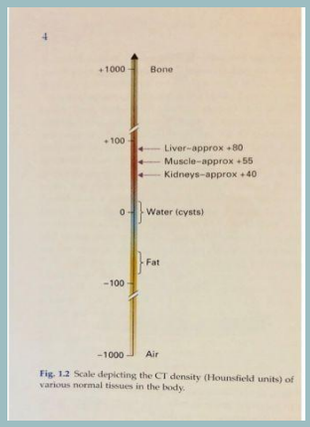
Urinary system

Kidneys | Ureters | Urinary bladder | Urethra

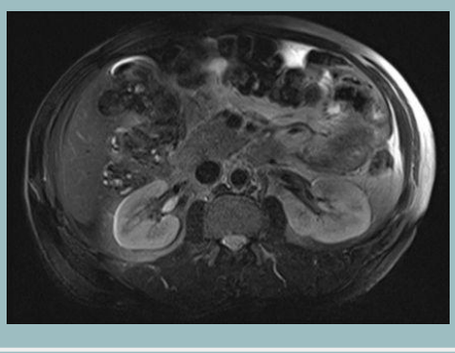
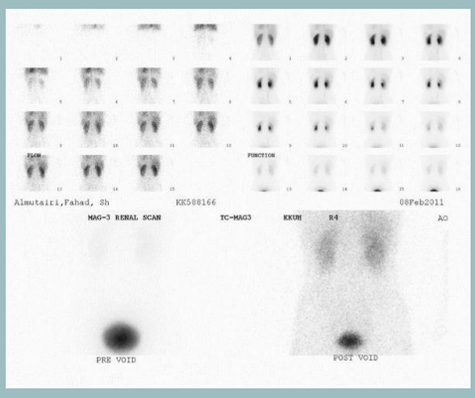
Imaging Modalities

Imaging Modality		Features
Plain X-Ray R L  Where is the right/ Left in the image?)	• First Imaging modality • Cheap. • Useful for radio-opaque (white) stones. • x- ray is the basic modality in the beginning.(but not specific, only directs us to the abnormality) after we do either US or CT • "KUB" is X-ray of kidney, ureter, and bladder. • Gives us quick diagnosis of renal colic (used in emergency department) • **442**: Indications of X-Ray: stones, renal colics, and if we want to follow up of stone after few days	• Projectional image. • (Bi Dimensional) • Image contrast determined by tissue density. • Good evaluation of radio-opaque stones. • **442**: Eg of renal stones: 1-ca oxalate 2-ca phosphate 3- uric acid 4- cystine stone 5- infection related • **442**: Most common stones are Ca: high dense radiopaque • Radiolucent stone: uric acid
Intravenous Uíogíam (IVU)/(IVP) 	• Conventional x-ray + IV contrast • Cheap. • Recently replaced by CT and MRI. • Useful for radio-opaque stones • **442**: We almost never do IVU now because we have better options • **442**: do we use it IVU nowadays? yes but rarely and you don't have to know it • If there is a stone obstructing the right renal pelvis, how do you think the image will appear?	• Projectional image. (Bi dimensional) • Image contrast determined by tissue density and IV contrast. • Good evaluation of collecting system and radio-opaque stones. • **442**: in IVU : stones- tumors- blood clot all will appear filling defect(useless)

Imaging Modalities

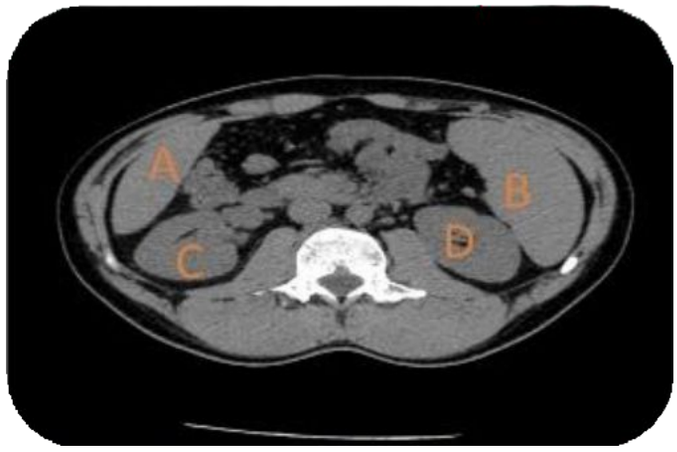
Imaging Modality	Features
Ultrasound (US) 	• Uses High Frequency Sound Waves (No Radiation). • Contrast between tissue is determined by sound ieflection. (the contrast is seen based on if the organ deflects/absorbs the US waves depending on the density of the organ) • **442**: Best for fluid: liver,spleen,kidney, Bladder. • **442**: good for fluid in general, fluid appears black	• Projectional imaging (Bi dimensional) • Operator dependant. (The operator decides to save images of what he thinks is significant. So maybe they miss saving something. (needs experience) While in CT and MRI images are taken for everything independently of the operator.) • Good resolution. • Used for stones , hydronephrosis(mainly), • cysts and focal lesions. • Terminology: hyperechoic/ hypoechoic • What should be done if we discovered a focal renal non-cystic lesion in a routine renal ultrasound ?
Computed Tomography (CT) Fat  renal sinus fat  Fig. 1.2 Scale depicting the CT density (Hounsfield units) of various normal tissues in the body.	• Same basic principle of radiography (uses X-Ray). • More precise. • Costly. • +/- contrast.=risk • Useful for trauma, stone, tumor (with contrast),and infection, **442: dr didn't mention it** **CT densities in Hounsfield units:** • Bone has +1000 (Highest density) • Soft tissue 40-80 , according to which organ • Blood 40 • Water 0 • Fat -100 • Air -1000 (Lowest density)	• Cross sectional images. • Image contrast determined by tissue density +/- contrast. • Better evaluation of soft tissue. • Not time consuming • Terminology:h • yperdense/ hypodense Usually CT of kidneys is without contrast (e.g. **we don't use contrast for assessing stones**) but we add contract to get more details and to assess the other pathologies because in CT without contrast,all tissues will have the same shade of grey **442**: -If CT was done without contrast, masses- fat- tissue all will have the similar appearance

Imaging Modalities

Imaging Modality		Features
Magnetic Resonance Imaging (MRI)  	• Better evaluation of soft tissue. • Uses magnetic field (No Radiation). • Used in patients allergic to iodine or with poor renal function. • Expensive. • Useful for soft tissue pathology: tumor (staging), infection • Rarely used nowadays for stones purpose Disadvantage: • expensive • time consuming • contraindicated in patients with pacemaker • not for claustrophobics	• Cross sectional images. • Image contrast determined by tissue properties. (H2O and H+ content) • Excellent for soft tissue evaluation. • Good for tumors • Terminology; hypersignal/ ○ hyposignal
Nuclear Medicine 	• Utilizes a gamma camera and radioactive isotopes. Radioactive material injected into patient intravenously, the radioactive source is the patient • **Functional test.** • Less expensive. • Useful for: obstruction and **split function** • **442**: -If we want to assess the degree of function of each kidney (separately) we use nuclear medicine because it assess "split function" of each kidney separately (the normal kidney takes the radioactive material more than the failing kidney. The failing kidney • functional kidney: material pass through kidney and get out with urine • in renal failure: kidney doesn't take the radioactive material.	• Projectional image. • image contrast by tissue uptake and metabolism • **442**: it's good to assess the degree of kidney function (GFR) unlike CT/ MRI • if patient with ureter stenosis and we want to know if its functional and needed to removed or non functional and no need to remove • > if radioactive material going easily: no need for treatment • > if radioactive material in not passing: renal function is affected and needs treatment

Indications for urography

Q)Where is the left kidney?
D (Don't forget in all radiology your left is the pictures right (opposite)...
except in nuclear medicine (also called scintigraphy) the right is also right (same side). We always say that nuclear medicine is used to assess function... here also CT with contrast is used to assess the function of renal system



So about the Imaging modalities I want you to know:
1-The difference between the modalities
2-the mode of action of each modalities
3-what we use mostly with kidney are IVP, CT urography, US

Main indication for urography : not found in 442 slides

Indication of intravenous Urography or CT urography

- When detailed demonstration of the pelviceal system and ureters are required.
- In suspected ureteral injury ex.following pelvic surgery or trauma. ex:C section they cut the ureter by mistake we will see hyperdense material
- Assessment of ureteric colic.we stait with KUB and US then we do CT without contrast then CT with contrast

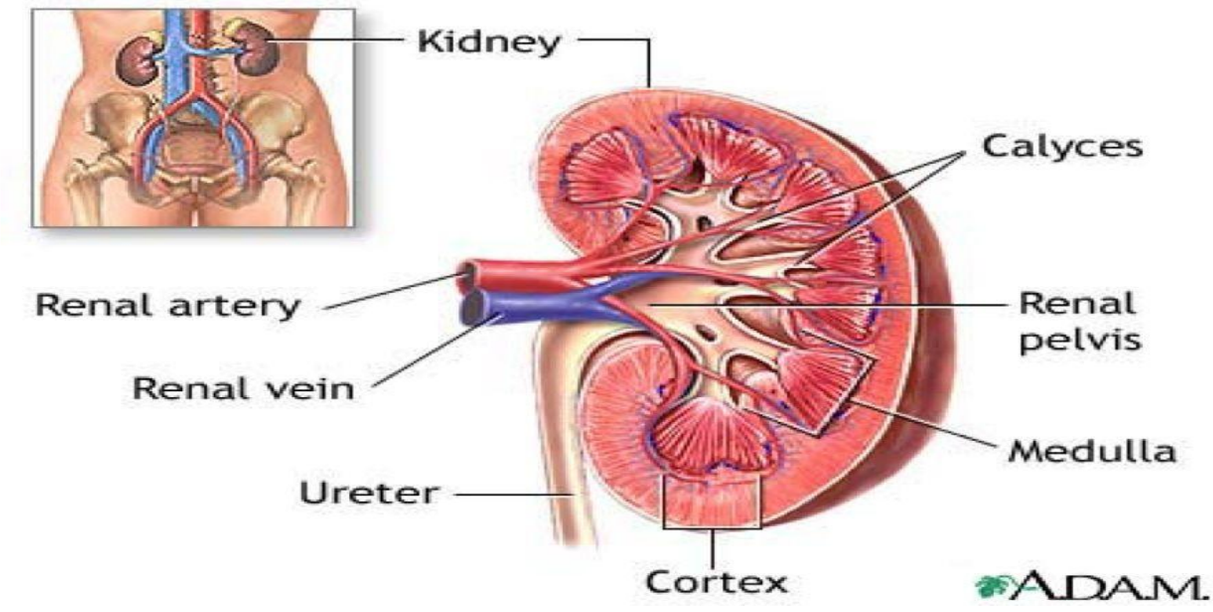
Indications of CT urography (more geneíal)

- investigation of renal calculi.
- mainly, Investigation of haematuria.suspect tumor
- Characterization of renal mass.
- Staging and follow up of renal carcinoma. (tumor)
- To delineate renal vascular anatomy .(e.g. suspected renal artery stenosis, prior to live related kidney donation, renal vein thrombosis, to know the kidney is ok and not infarcted,atrophied oi scarred).
- To diagnose / exclude renal trauma

1- Every image has a denotation which should be interpreted correctly
2- Basic anatomy should be well known & how anatomic structures appear & relate to each other in different diagnostic imaging modalities
3- To know the normal in radiology, you should know the anatomy
4- To differentiate abnormal (Pathology) in radiology, you should be familiar with the normal findings

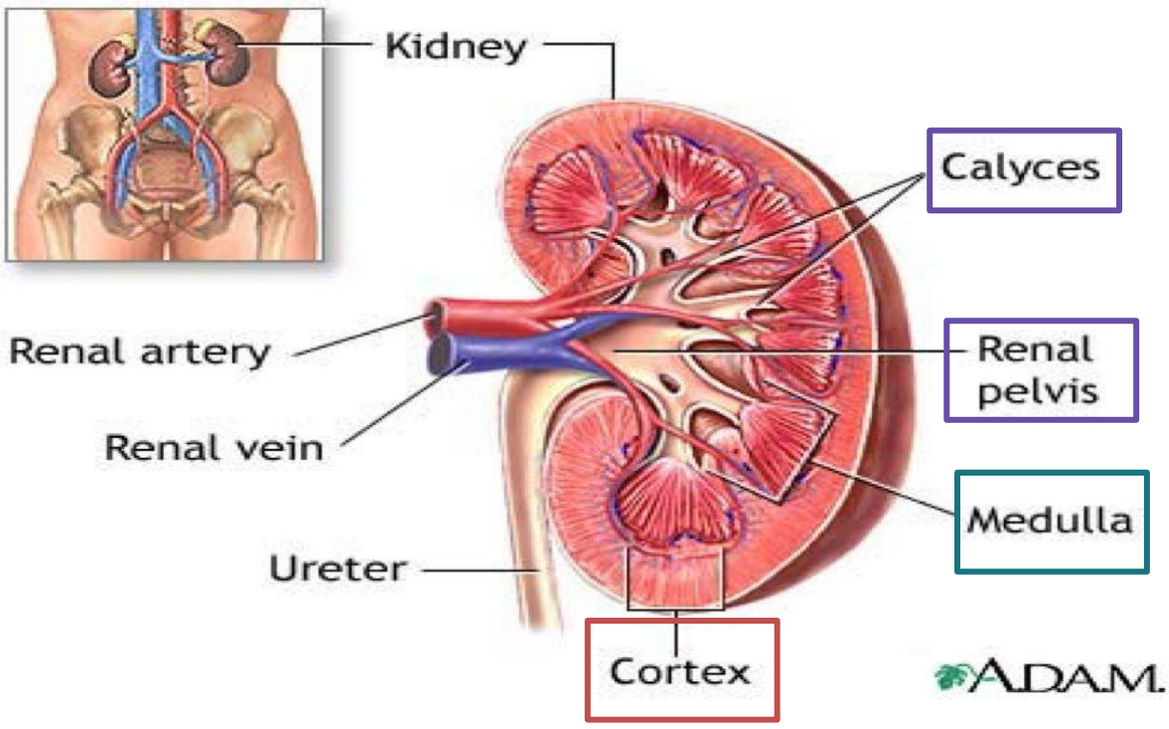
Kidneys Anatomy :

- Bean shaped structure. Consist of coitex, medulla , collecting system.
- On either side of the lower thoracic and upper lumbar spine.
- Usual location – between (T11-L3). T11= superior pole, L3= inferior pole. If you got confused where kidneys are in an image, look between T12-L1 while the renal arteries are.
- Right kidney is 2 cm lower than the left kidney. **442:because of the liver**
- **left kidney is higher, when we do renal biopsy we do it on right kidney to not to damage the lung**
- Long axis of the kidneys is directed downward and outward, parallel to the lateral border of the psoas muscles. If they are not parallel that Indicate a problem mainly (mass)
- **442**: the right and left kidneys are perfectly cranio-caudaly straight? no, but they are parallel to psoas muscle
- **442**: psoas muscle is originated from transverse process in the back, the extend anteriorly and inferiorly (extend anteriorly, inferiorly laterally)
- **442**: so kidney is parallel to psoas muscle anteriorly (lower pole of kidney: anteriorly)
- cranio-caudal axis are diverging outside inferolaterally following the psoas muscle
- Lower pole is 2-3 cm anterior to the upper pole. so we have to put the US (**442**: best method to measure the size of the kidney) probe in the light anatomical position in order to get a good sagittal view of the kidney, also while inserting a catheter it's important to know the right anatomical location of the kidney.



Kidneys Anatomy :

- Normal size: in adults 10-12 cm.
- Kidneys are visualized on the X-Ray due to presence of perirenal fat (contrast effect). (which gives us the contrast because it has a different density)
- **442**: on CT & MRI: the more the obese the patient, the more easier to see organs and pathology, why? fat will separate everything
- **442**: on US: the more the patient is thin the easier to see organs and pathology
- > on CT & MRI we love fat patients , on US we love thin patients
- They (The kidneys) are contained within the renal capsule and surrounded by perirenal fat = normal contrast and enclosed within the Gerota's fascia.
- Perirenal hemorrhage, pus and urine are contained within the fascia and detected on CT and US. Ex perirenal hematoma,perirenal urinoma



- **442**: cortex:
- 1- contains glomeruli, when we take a biopsy we take it from the cortex because we want to see the glomeruli.
- 2- on US: lighter than medulla

- **442**: medulla:
- 1- blood filtered in cortex & excreted in medulla, this helps us in US,
- 2- on US:medulla appears darker than cortex cuz it has more fluid

Conditions associated with enlarged kidneys Important 442 dr: no need to memorize it just focus on examples on slide 10		
	Diagnosis	Imaging
Always Unilateral	Compensatory hypertrophy.	Opposite kidney small or absent
May be Unilateral or bilateral	Bifid collecting* system Upper pole goes to separate renal pelvis and lower pole goes to another separate pelvis and even sometimes there is double ureter causing hypertrophy	Diagnosis obvious from abnormalities of collecting system
	renal mass	Mass is seen
	Hydronephrosis** collection of urine in kidney caused by obstruction	Visible distension of the ienal collecting system
	Lymphomatous infiltiation	May show obvious masses; the kidneys may, however, be laige but otherwise unremarkable
Always bilateral	Renal vein thrombosis.	No Doppler signal is visible in the renal vein and thrombosis may be evident.
	Polycystic disease	Characteristic imaging appearance
	Acute glomerulonephritis	Non specific enlargement
	Amyloidosis	Non specific enlargement (rare)

Important

Conditions associated with small kidneys 442 dr: no need to memorize it just focus on examples on slide 10		
	Diagnosis	Imaging
Unilateral but may be bilateral	Chronic pyelonephritis	Focal scais and dilated calyces
	Tuberculosis	
	Obstructive atrophy	Dilatation of all calyces with uniform loss of Renal parenchyma
	Renal artery stenosis or occlusion	Outline may be smooth or scarred, but the calyces appear normal
	Hypoplasia	Very rare; kidneys may be smooth or irregular in outline with fewer calices may be clubbed
Always bilateral	Radiation nephritis	Small in size but no distinguishing features
	Chronic glomerulonephritis of many types	Usually no distinguishing features. In all the conditions the kidney may be small with smooth outlines and normal pelvicalyceal systems
	Hypeitensive nephropathy	
	Diabetes mellitus	
	Collagen vascular disease	
	Analgesic nephropathy	Calyces often abnormal

Conditions associated with change kidney sizes (imp)
442: focus on these instead of the previous tables

causes of enlarged kidney?
1- hydronephrosis

2- tumors

3- polycystic kidney disease (multiple cyst)

causes of smaller kidney?
1- chronic kidney disease

2- ischemia: eg. Renal artery stenosis
case: young patient with hypertension on hypertension medication? suspect renal artery stenosis

442 Dr's cases

Q) what modality should we use?

a. patient suspected to have stone? what's the first choice of modality?
   1. X-Ray (shows nothing but still suspected stone? do 2)
   2. CT without contrast

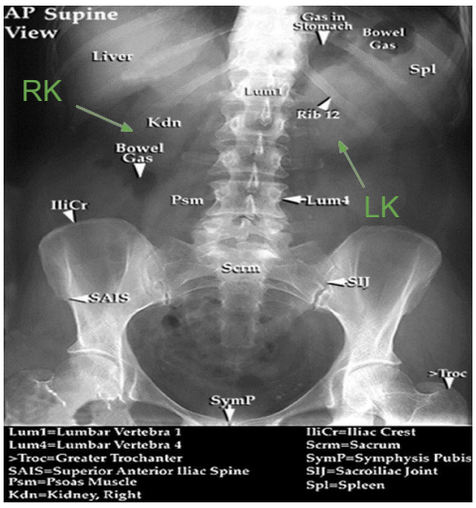
b. patient known to have pelvic cancer and abnormal renal function & suspecting hydronephrosis?
1. US

c. patient with possible mass, on US it shows no cyst?
1. CT with contrast or MRI with contrast

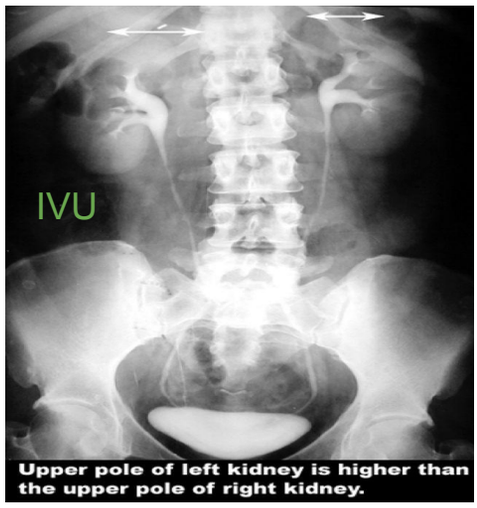
d. patient with ureter stenosis and we want to know if its functional affecting or not functional affecting?
1. nuclear medicine

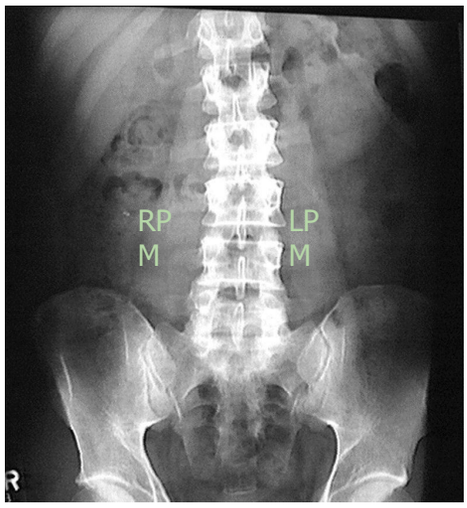
e. patient with 2 kidneys, one of them is damaged and we want to remove it but first we want to assess the functionality of the damaged to know if it contribute the majority of renal or we can remove it?
1. nuclear medicine

kidney

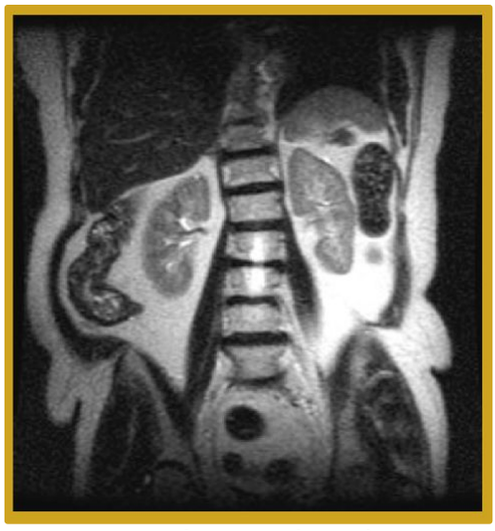


We don't usually see ureters (they are collapsed) in X-Ray unless we are using contrast

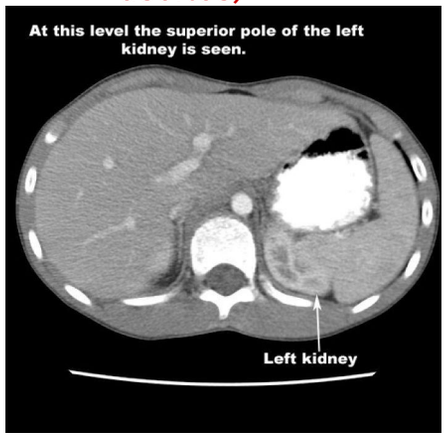




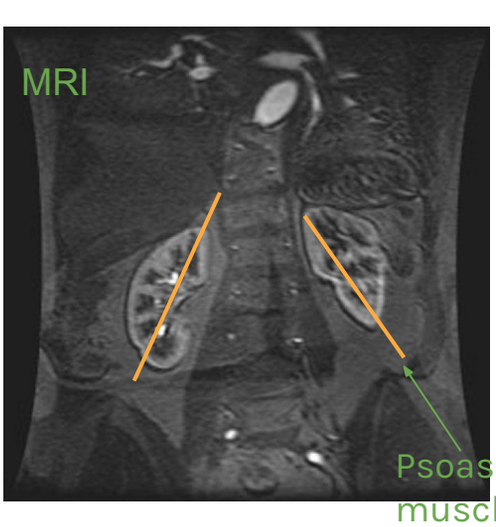
Kidneys are retroperitoneal
442: kidney behind peritoneal SAC organs and may be obscured by bowel loops (
442:if there is a renal damage, urine will go to retroperitoneum, urine will not go to bowel and won't cause ascites)



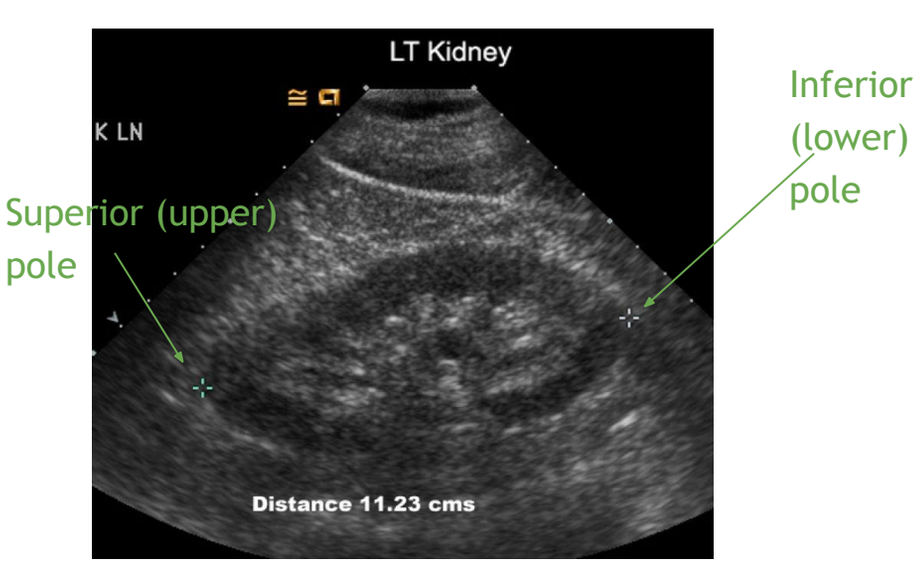
Coronal MRI showing Left Kidney is higher than Right Kidney
442: kidneys are surrounded by fat



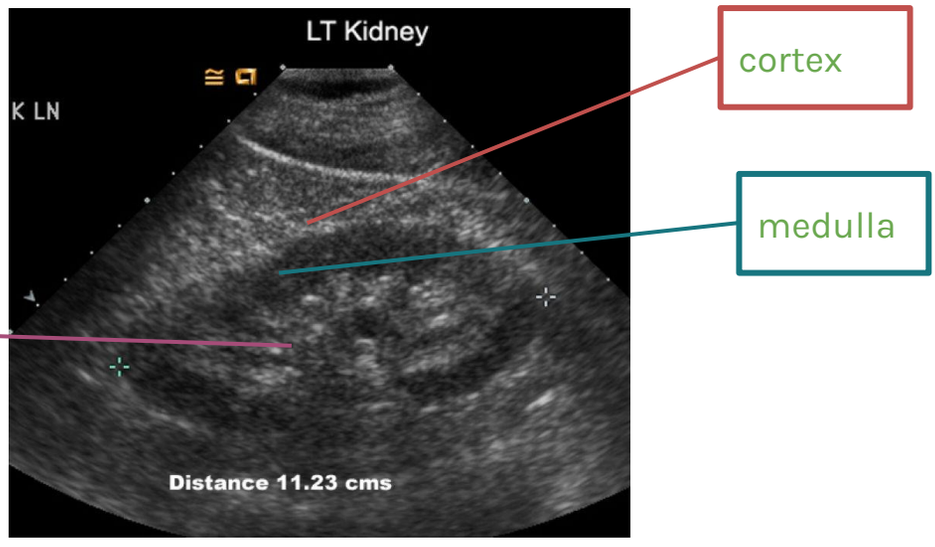
CT Scan showing left kidney higher than right
Remember that right kidney is lower in level that left kidney (because of liver)
so in CT don't quickly think of an absent kidney!
Maybe it's just the level of the image



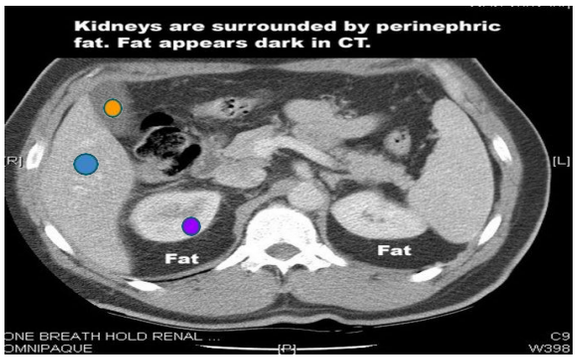
Long axis of the kidneys is directed downward and outward, parallel to the lateral border of the psoas muscles



Ultrasound is the best method to measure the size of the Kidney and the structure

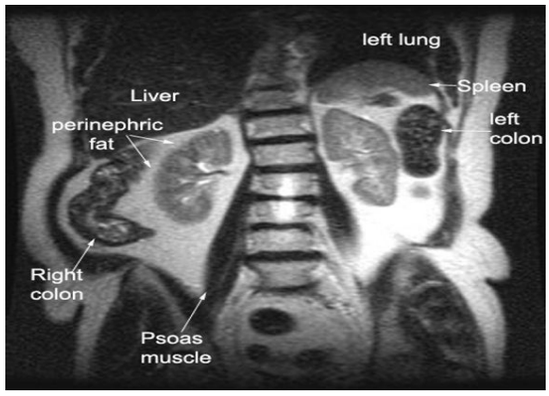


442:
-normally, we can't see the calyces
-we see calyces on US in case of hydronephrosis



This image shows CT with contrast.

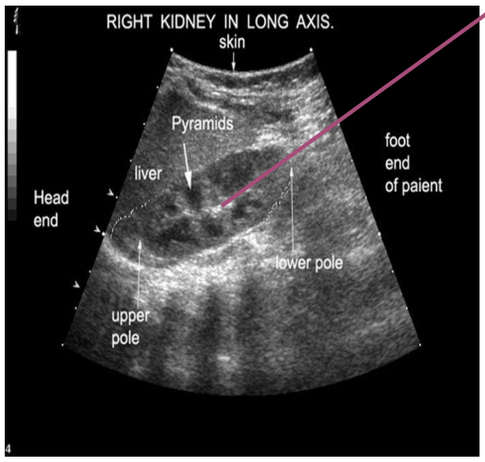
- liver appears hyperdense
- gallbladder appears hypodense
- we can visualize the kidney borders because of the difference in densities between the kidney and the perirenal fat. (regular definite borders)



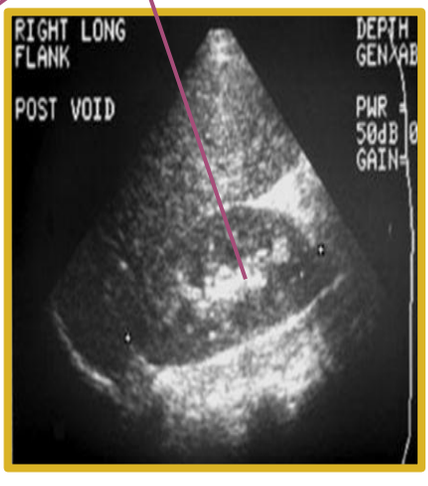
MRI: Fat is bright in T2 (natural contrast)

Ultrasound of the kidney:

renal sinus fat



sagittal Ultrasound of Right Kidney (in pediatric).upper pole is always on your left



Normal study

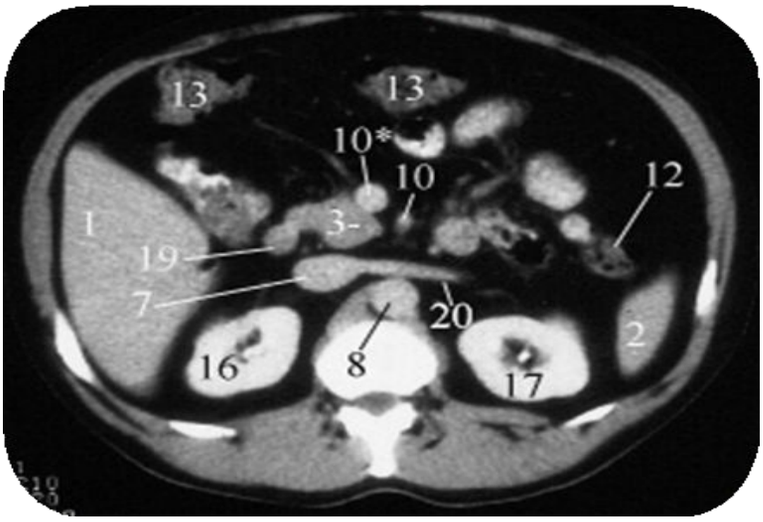
Collapsed, hyperechoic collecting system=normal no obstruction or dilation

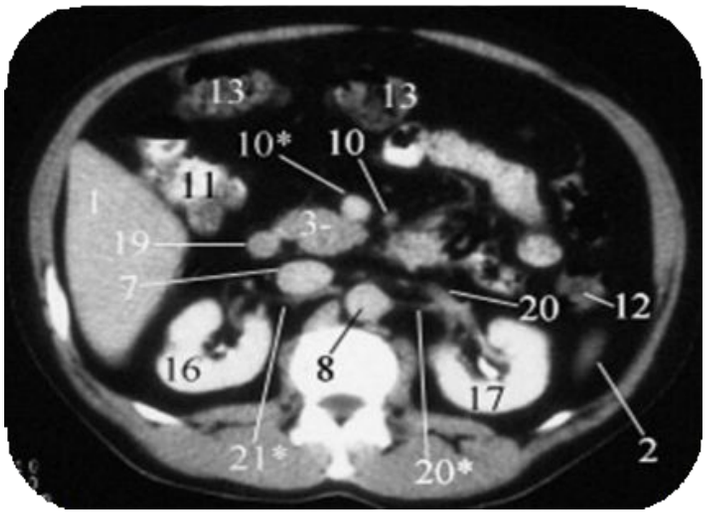
Dilated Renal Pelvis (obstruction)

442:(hydronephrosis)

CT Scan of the kidney: **VERY Important!**

1- Liver.
2- inferior part of the Spleen.
3- Pancreas.
7 IVC
8 Aorta.
10-superior mesenteric artery
11-Bowel.
12-Descending colon.
13-Transverse colon.
16-Right kidney.
17-Left kidney.
19-mesenteric vein
20-Renal vein.





442: Remember:
Renal **veins** are **anterior** to Aorta
Renal **arteries** are **posterior** to Aorta (right renal artery is posterior to IVC)

Renal Vasculature: IMPORTANT

- Renal arteries branch from the abdominal aorta laterally between L1 and L2, below the origin of the superior mesenteric artery.
- The right renal artery passes posterior to the IVC.

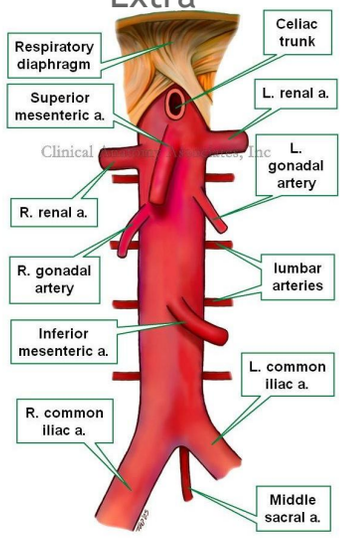
- There may be more than one renal artery (on one or both sides) 20-30% cases. (accessory renal arteries)
- Renal veins drain directly into inferior vena cava.

- Renal veins lie anterior to the arteries (useful to know in Doppler study).

- Left renal vein is longer and passes anterior to the aorta before draining into the inferior vena cava.

- The left gonadal vein will drain into to left renal vein while the right gonadal vein drains directly into the inferior vena cava

Extra



●Q: What are the main branches from abdominal aorta? **442**: from up to down:
1- celiac trunk and its branches (left gastric artery,splenic artery,common hepatic artery)
2- superior mesenteric artery
3- renal arteries then
4- inferior mesenteric artery

- So renal artery is located between the superior and inferior mesenteric.

442:

●SMA comes from aorta, and there are structures in between (between SMA and aorta) these structures are:
1- renal vein 2- 3rd part of duodenum

- if 3rd part of duodenum is compressed ? especially in pediatric patient he is malnourished, we give him oral given barium it will stuck> called SMA syndrome.
- if renal vein is compressed? the presentation will be : blood from kidney can't go to IVC, blood will accumulate in gonadal vein cause A. male: varicocele B. female: gonadal varices > called nutcrackers syndrome

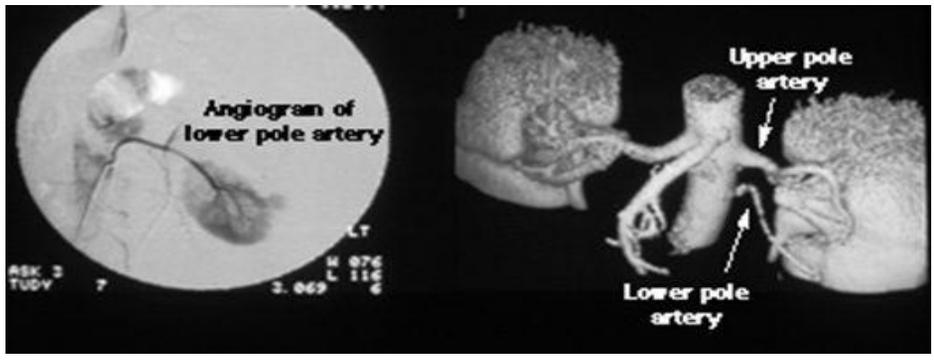
●Since left gonadal vein drains into left renal vein, more hydrostatic pressure is put on left renal vein and that may cause a condition called varicocele in males. (Which side does varicocele commonly occur? Left.) While in females may cause pelvic congestion syndrome.

●Gonadal vein in males is testicular oi spermatic vein while in females it is ovarian vein.

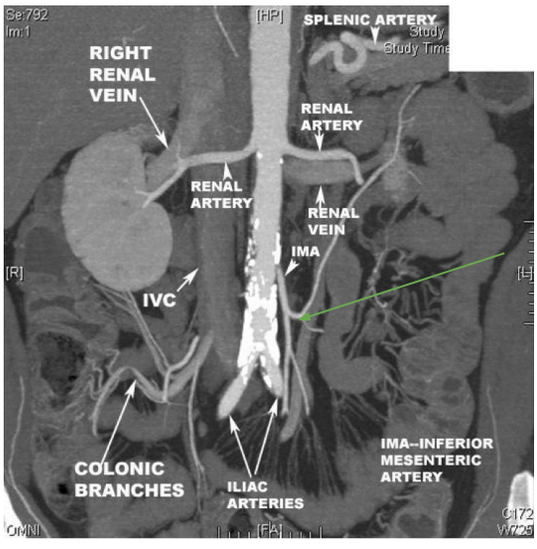
Renal angiography

- It was used before CT (we don't do it routinely)
- It's important to know the anatomy because sometimes there is an accessory renal artery (extra artery) that is mostly connected to the lower pole of the kidney.
- *Why it is important to know if there is an extra renal artery?* Because if you were planning to do a nephrectomy to this patient and you don't know about this extra artery then a hematoma might happen and the patient may die (so they make this reconstructive CT before surgery)

Normal Supply Of Both Kidneys each By Single Renal Artery

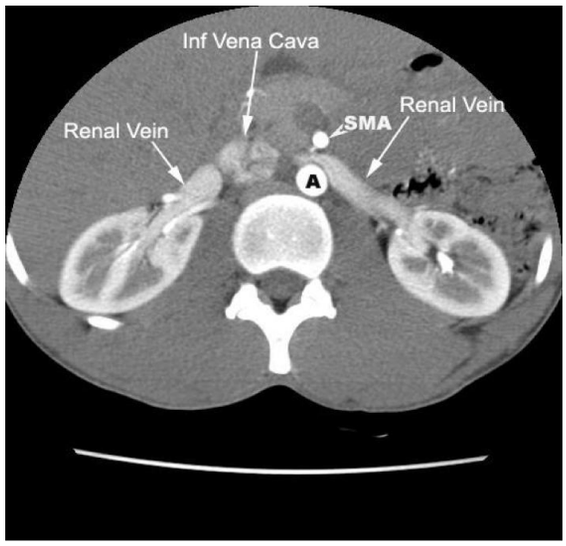


Left Kidney Supplied By Two Renal Arteries=accessory renal artery in lower pole,



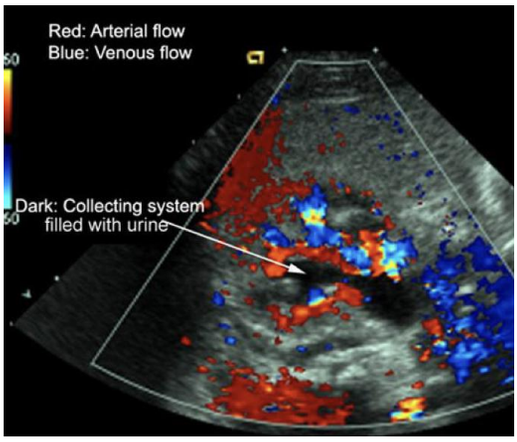
Coronal CT reformat

Coronal reconstruction of CT with IV contrast. We see calcification of the aorta. Why we see the artery more dense? We call this (arterial phase) because the contrast is now in the arteries.

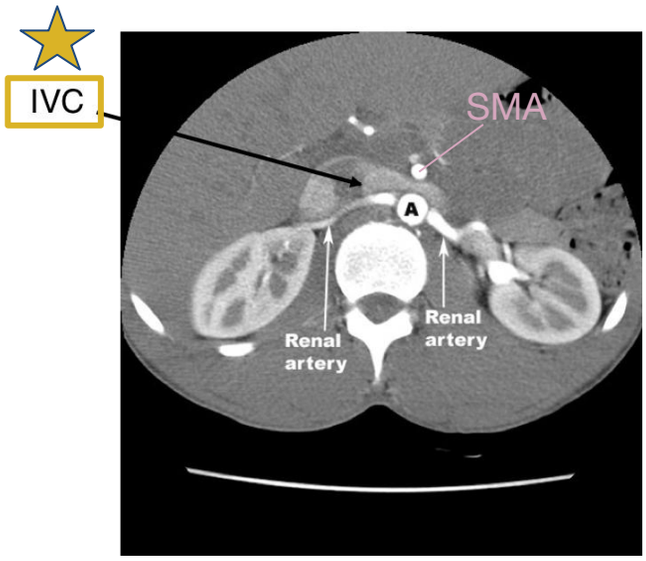


Left Renal Vein Passes Anterior to the Abdominal Aorta and posterior to superior mesenteric artery (SMA), sometimes left renal vein is compressed between superior mesenteric artery and abdominal aorta which causes left renal vein stenosis (nutcracker syndrome) causing renal congestion, hematuria, and left flank pain.

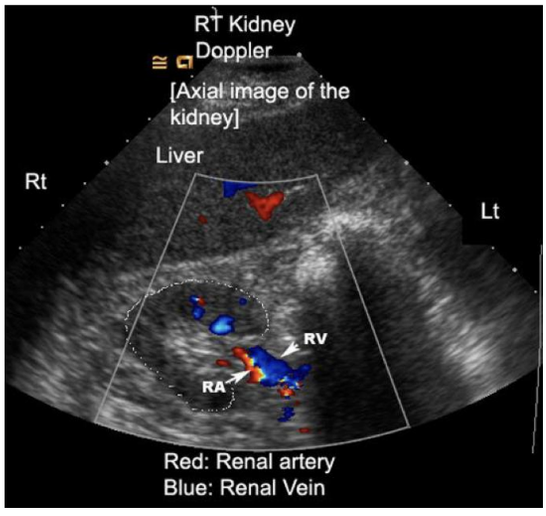
kidney



In US doppler we can assess blood and. Here we see high blood flow in arteries and veins but we don't see urine because urine is low flow (not quick) so in doppler it appears black while blood in arteries and veins appear colored.

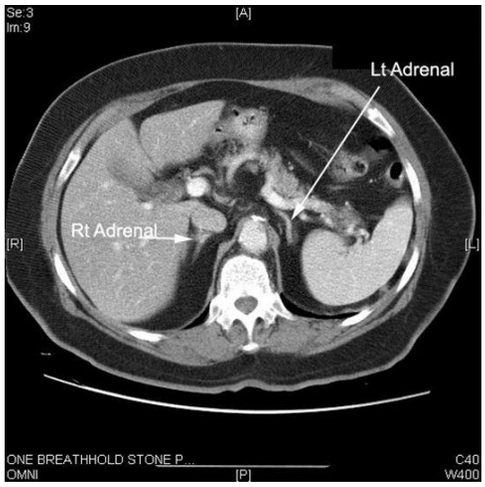


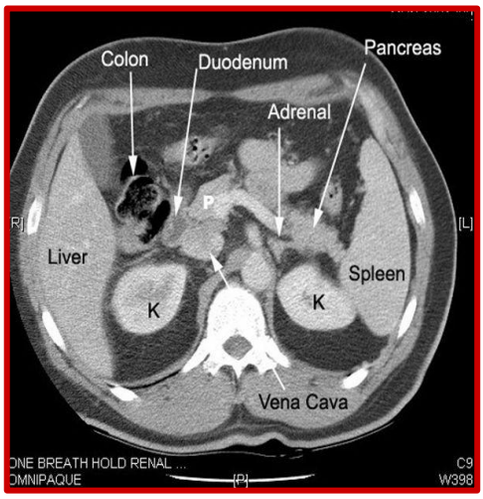
When you want to image arteries or veins with contrast remember it's all about the timing.
Here we don't see contrast in renal veins because of the time when the image was taken. (no contrast, non enhanced phase) If you want to image with contrast you will
inject it to a vein (e.g. in hand of patient)
1) within few seconds, the contrast will reach the heart via vena cava
2) then become pumped into aorta and different major arteries in the body (arterial phase) (after 20-30 seconds of injecting contrast it reaches arteries)
3) wait for the blood to be exchanged within the capillaries which will to back to veins
again. This is called (venous phase) which takes 70s.
4) then there is the (nephrogenic/ excretory) phase which is 70-80s to visualize the cortex of the kidneys

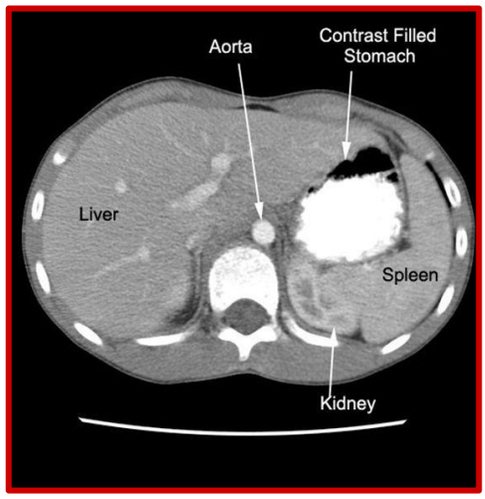


Doppler study: Renal Veins Lie Anterior to the Arteries
442: Always the arteries are deeper than veins

Relations of the kidney :







Adrenal Glands are superior to the Kidneys

It's important to know the basic structures ex: liver,pancreas, aorta, IVC, spleen, question may come as labeling along with the labeling pictures on page 9

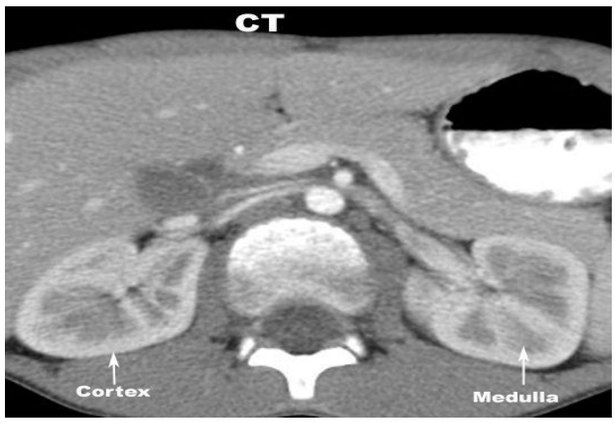
Renal Structure:

Cortex

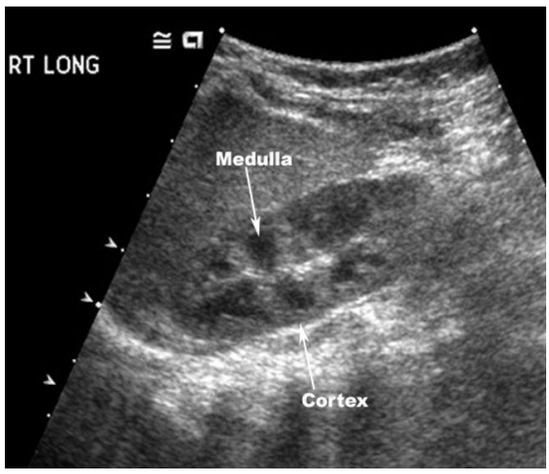
- Renal cortex consists of glomeruli and renal tubules. Glomeruli are the functional units of the kidney.
- Normal thickness is 2.5 cm. When the thickness is less than 1cm that means there is cortical thinning which can give us an early indication of renal failure,so determining the thickness by US can help us determine the function of the kidney

Medulla

- Consists of multiple renal pyramids.

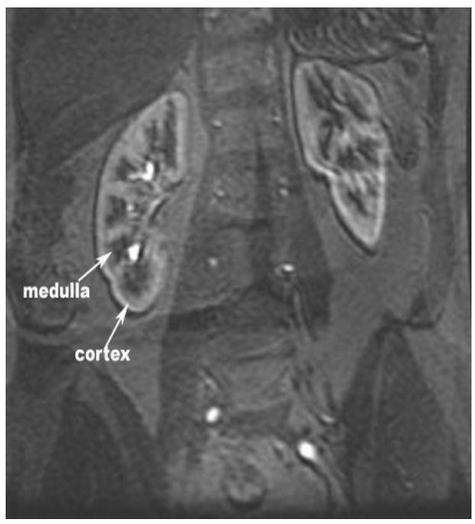


Normal kidney showing hyperdense cortex and hypodense pyramids of the medulla

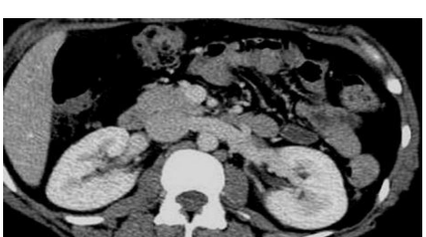
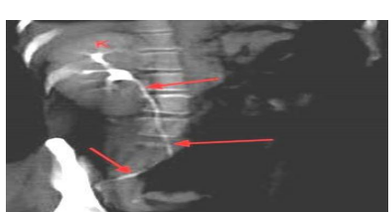


Ultrasound of Right Kidney showing Normal hyperechoic cortex and collecting system and hypoechoic pyramids of the medulla

If you can see collecting system there must be obstruction causing dilation, normally you should not see it on US



MRI OF Kidneys

Nephrogram phase	Pyelogram phase	CT Urology
		
• Contrast enhanced CT scan through the kidneys in nephrogram phase (showing coiticomedullaiy differentiation). • Good differentiation between cortex and medulla indicates good function in contrast CT. • This is approximately 100 seconds following contrast administration and would show renal lesions well. • If the kidney isn't filtering well there will be thinning of the cortex foi less than 2.5 cm (remember that nephrons responsible of filtiation- air present in renal cortex). • Cortex appears more whitish than medulla.	• Contrast enhanced CT scan through the kidneys in **pyelogram phase** also called excretory phase (showing excretion of contrast into the collecting system). • This is approximately **8 minutes** following contrast administration and would show urothelial lesions well, such as transitional cell carcinoma, stones, blood clots. It will be seen as a **filling defect**	• 3D coronal reconstructed image from CT scan of the abdomen and pelvis known as **CT urography.** • **Nowadays, this exam is quickly replacing the conventional IVU.** • 3D reconstruction is performed through the right kidney (K) and follows the normal ureter (arrows) all the way to the ureter insertion into the bladder.

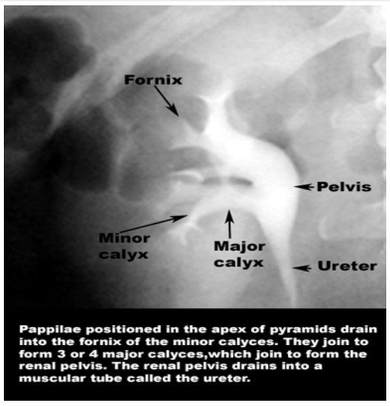
Renal Collecting System:

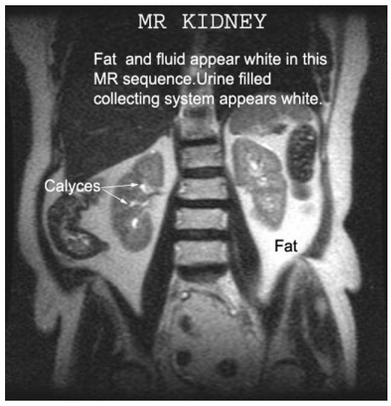
Calyces:

- Medulla sits in the fornix of the minor calyx.
- Papillae drain into minor calyces.
- Minor calyces coalesce to form 3 or 4 major calyces.
- Major calyces combine to form the pelvis.

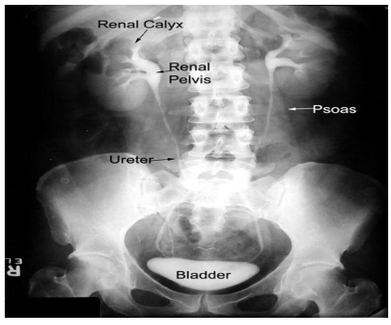
Pelvis:

- Broad dilated part of the urine
- collecting system, located in the hilum
- Renal pelvis drains into the ureter
- Collecting system is always hyperechoic in US, any change in the echogenicity may indicate an obstruction

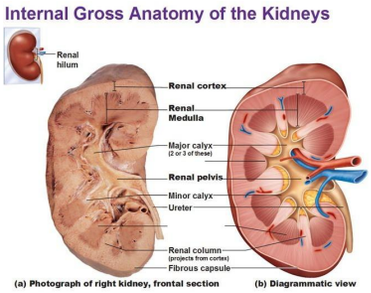




Calyces aie concave in shape, in case of obstruction they become flat and convex in severe hydronephrosis



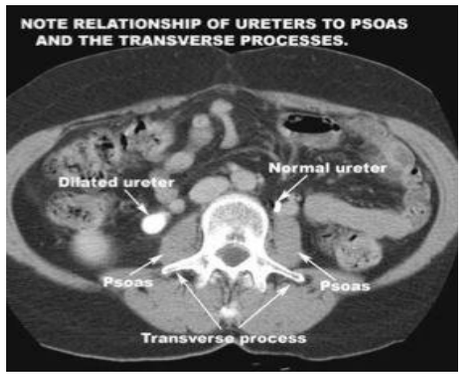
IVP



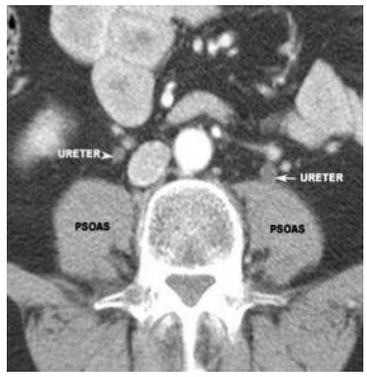
Urinary bladder

Ureters:

- 25-30 cm in length and 3 mm diameter. If diameter is wider than 3mm then it might be dilated because of a stone oi tumor obstructing down (To image the ureter we never use US, we use CT with contrast)



CT urography with contrast in excretory phase showing dilated ureter so if we scroll down we will probably see tumor or stone.Since this image show contrast inside ureters then this is **excretory phase**



Shows CT in arterial phase you see contrast in aoita but no contrast in ureter so poor assessment of the ureter

- **Three areas of normal narrowing:**
  1)Ureteropelvic Junction (most common) (start point)
  2)Bifurcation of the iliac vessels.
  3)Ureterovesical Junction. (end point)
  (When there is stone usually it impacts stuck) in these areas.

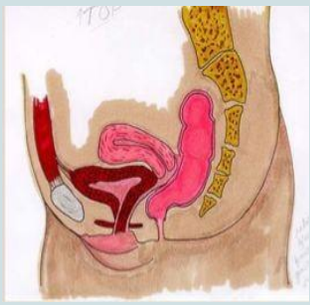
Urinary bladder:

- Size and shape vary considerably
- When empty, it is completely within the pelvis.
- Dome is rounded in male and flat or slightly concave in female because of the uterus
- Bladder is relatively free to move except at the neck which is fixed by the puboprostatic ligaments (males) and pubovesical ligaments (females).
- Peritoneal reflection - Rectovesical pouch in males and vesicouterine and rectouterine pouch in females..one reflection in males and two in females

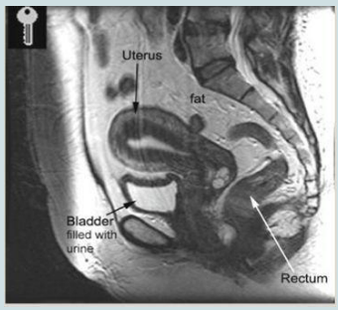
442: Urinary bladder injury (rupture):
1- Extra peritoneal = Foley catheter 2- Intra peritoneal = surgery

Anatomy of M&F pelvis showing the urinary bladder sagittal section

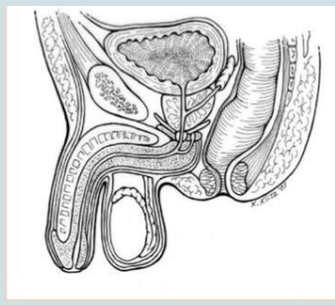
You should know the relation between the rectum,uterus,bladder to know how to interpret the radiological images



Female



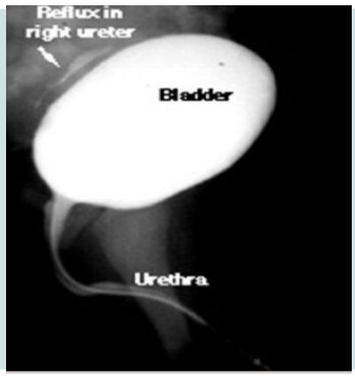
Female



male

Voiding Cystourethrogram

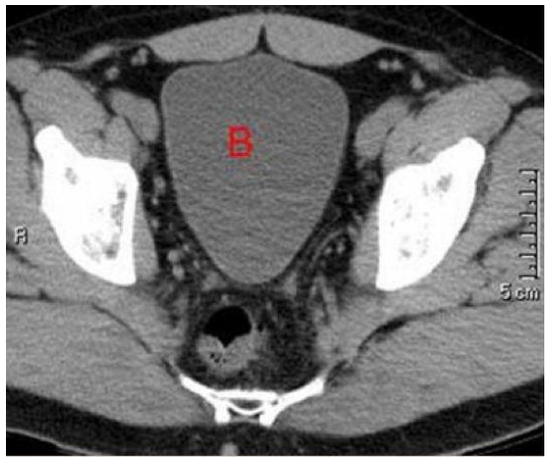
We inject contrast through urethra into the bladder to see if there is reflux to the ureter which is abnormal indicating vesicoureteral reflux
Important in pediatrics, usually used for infants present with recurrent UTI.



Urinary bladder cont..

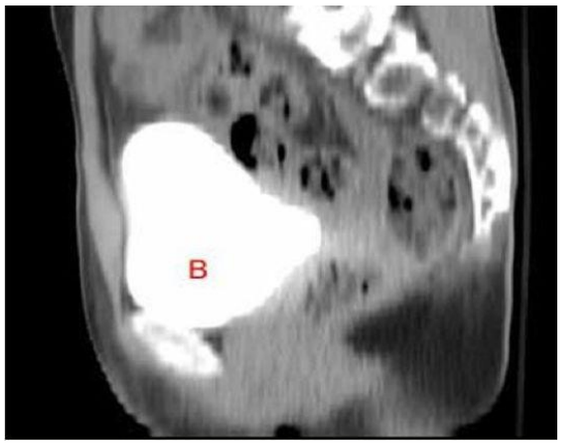
- Unenhanced CT scan through a normal bladder (B)shows a normal fluid density structure (less than 10 Hounsfield units on CT density scale).

Why the bladder is hypodense here? because of urine.

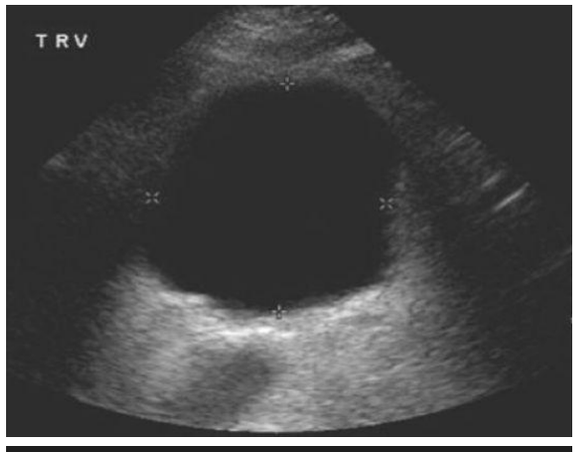


- 3D reconstructed sagittal image of a normal bladder in the sagittal plane following CT urography.
- This is delayed image 10 minutes following IV contrast administration, excreted contrast fills an otherwise normal bladder (B)

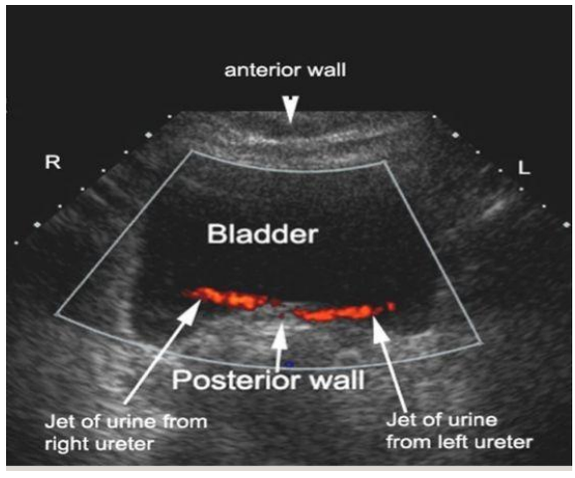
Bladder with filled contrast=late excretory phase(10s after IV contrast injection) very good for assessing urinary bladder tumors seen as filling defect.



- Transverse image through a normal urinary bladder(calipers "x"and"+"outline the bladder wall) using **ultrasound** shows normal anechoic structure (anechoic = no echoes = black).
- Bladder should be full before taking the US so that the bladder walls get distended and we can properly assess them

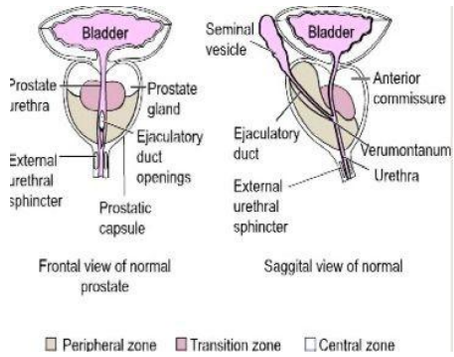


- Sometimes if we suspect presence of stones we use doppler to see the flow (when ureters want to void urine into bladder they contact. As a result, urine flows through ureters into bladder quickly, if one ureter is obstructed by stones we see difference in flow between the two sides). Normally we see two urethras jets,if we see one that indicates obstruction

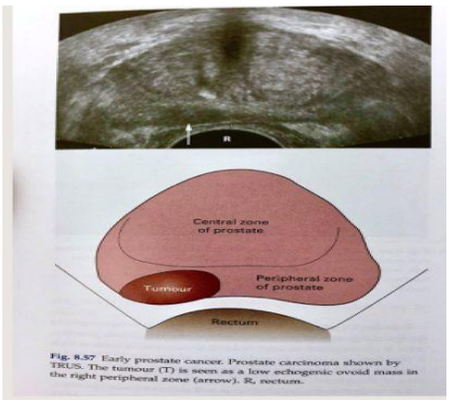


Prostate gland

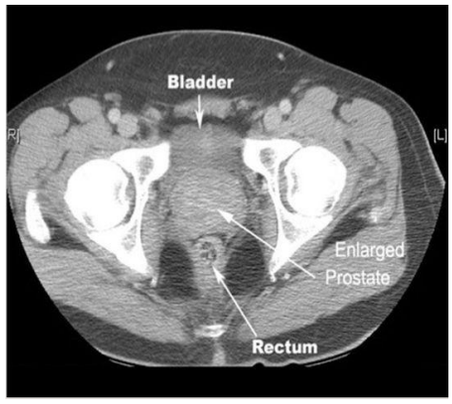
- Largest accessory gland of male reproductive system.
- Lies around the fiist pait of the urethra at the base of the bladder (Tr=Transitional) 4 cm x 3 cm (height) x 2 cm (AP) in size.
- Surrounded by dense fibrous capsule.
    - Anatomy of prostate gland:
- Base – closely related to neck of bladder.
- Apex
- Posterior surface
- Anterior surface.
- Anterolateral surfaces.
- Prostate gland can be divided into:
- An inner gland – transition zone.
- An outer gland – central and peripheral zones.



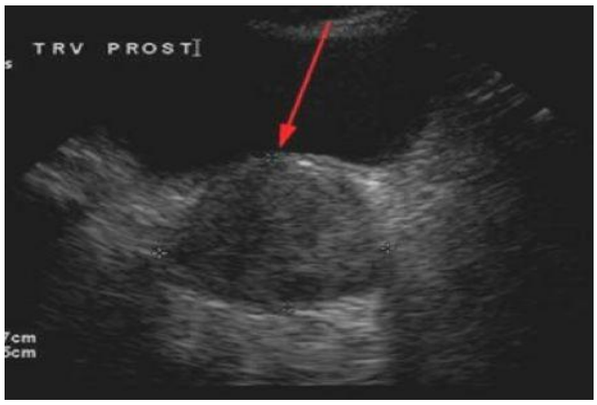
- Central transitional zone which lies in periurethral location is the site of benign prostate hypertrophy which can occlude the urethra.
- Posterior peripheral zone is the primary tumor site in 70% patients.

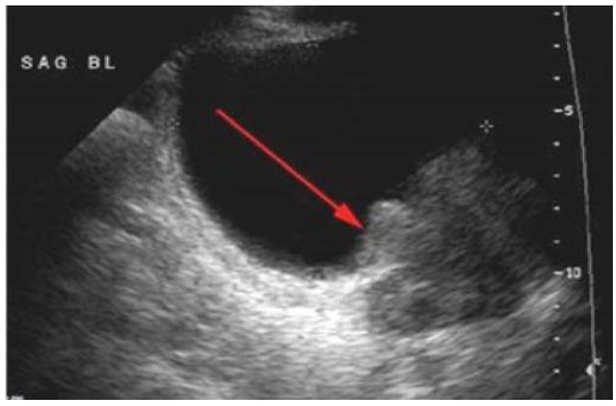


Hypoechoic tumor in the periphery



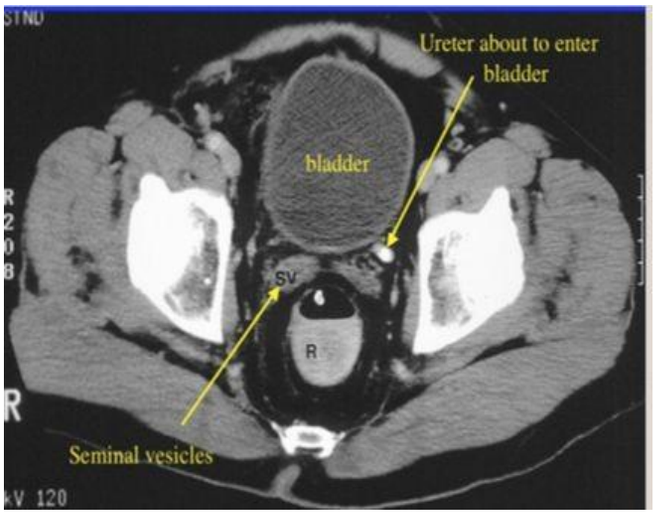
Usually CT is not good for prostate and pelvic organs in general, MRI is better

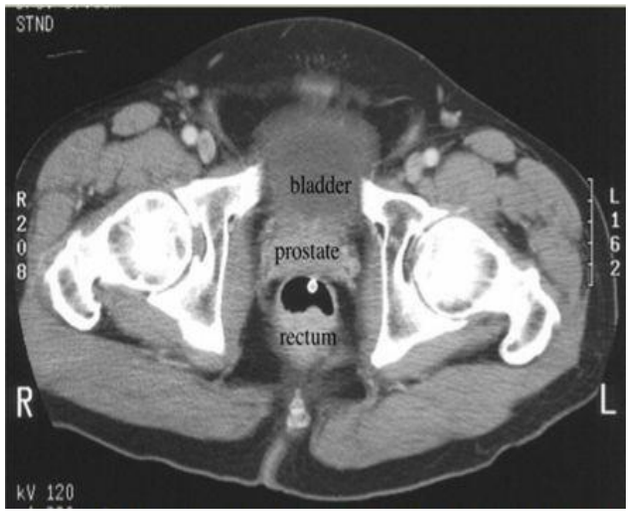




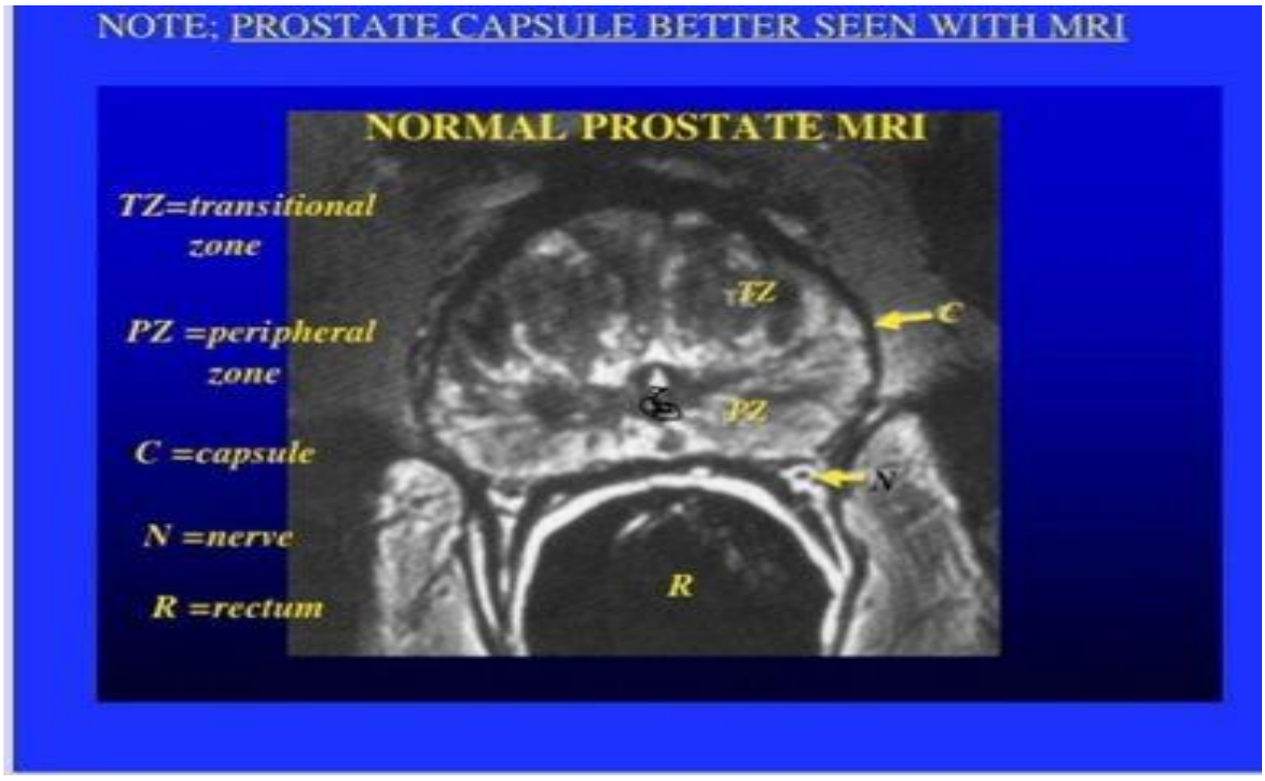
Axial section Sagittal section We can measure the volume of the prostate and the best way is by endorectal US (An US for the bladder, and the red arrows indicates enlarged prostate).

Prostate gland cont...





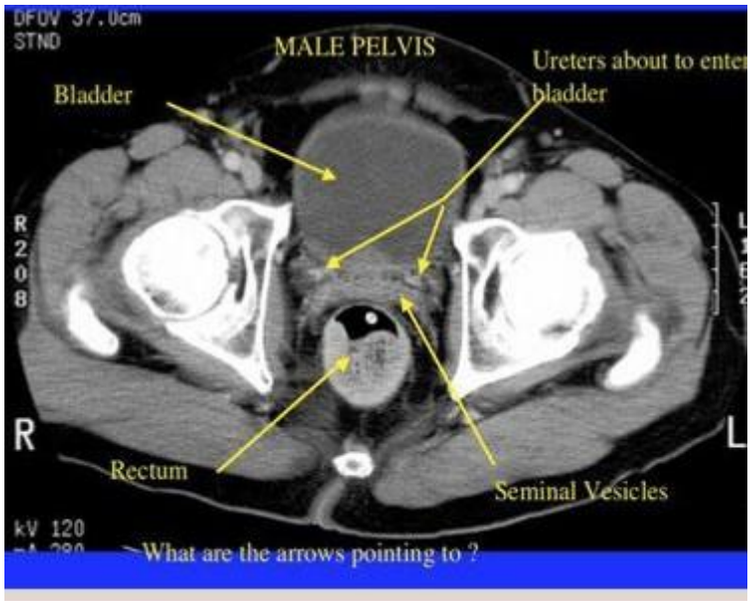
Prostate just anterior to the rectum easy to palpate on digital rectal exam

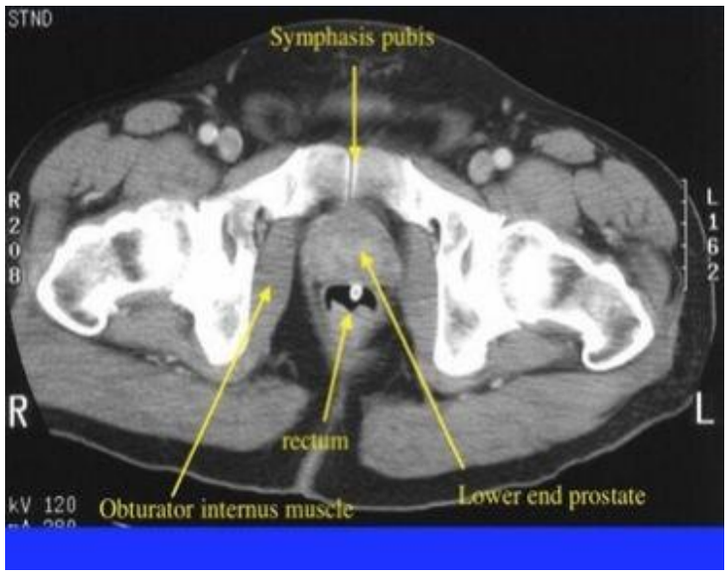


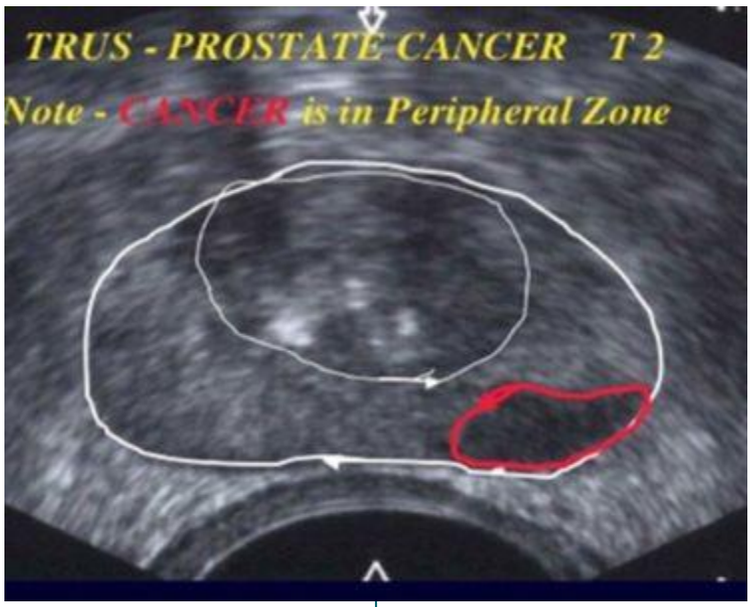
Best modalities:

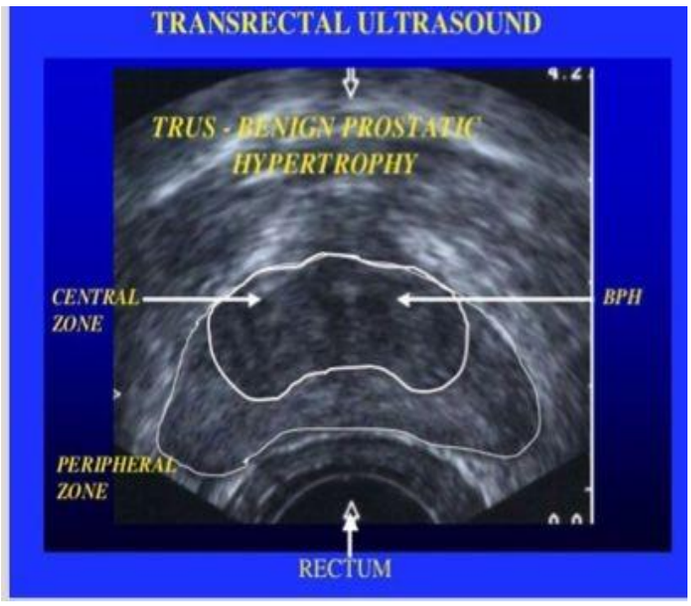
- prostate gland:
  - Endorectal (transrectal) ultrasound
  - MRI **(Best modality)**
- kidney: CT and US

Prostate gland cont..





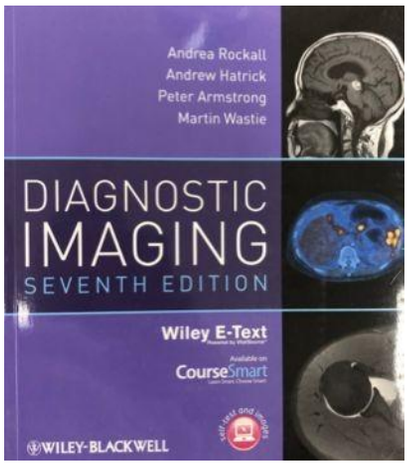




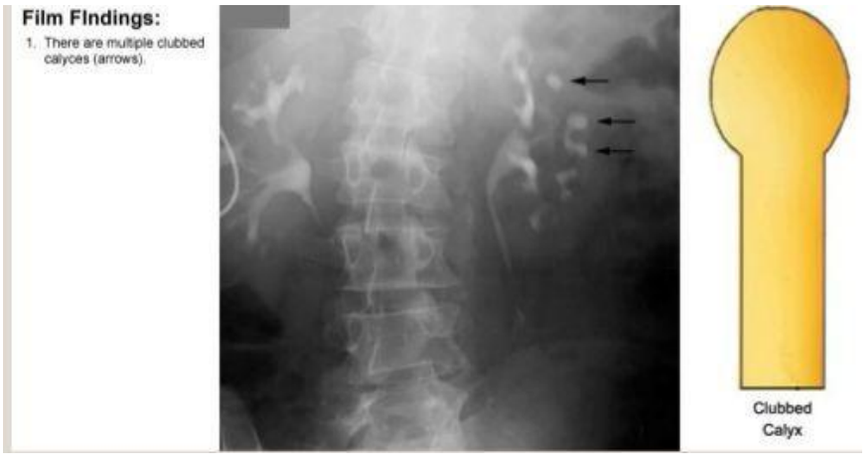
Hypoechoic seen in peripheral zones = tumor.
We can take a biopsy using the same probe.
After US we now should do MRI

”mostly i bring the questions from the slides and what i say during the lecture”

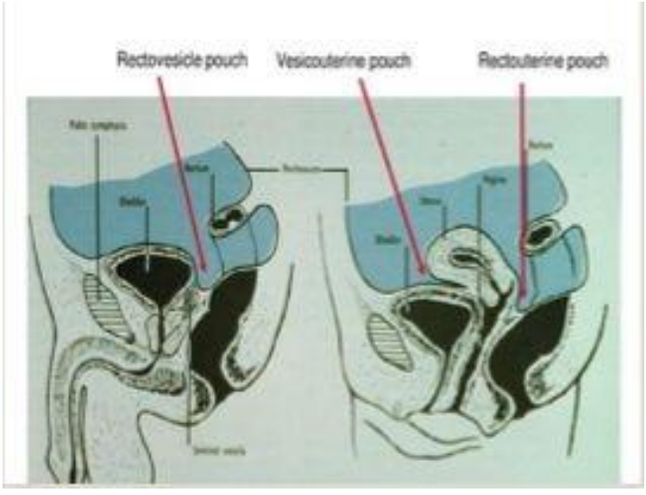
reference



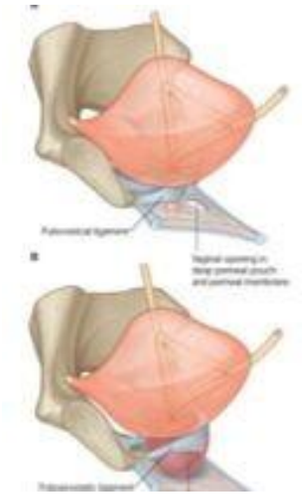
For better understanding:



if there is obstruction it will cause dilatation and calyces looks "clubbed like"



different pouches in males And females



different ligaments and pouches in males and females

Summary

Plain X ray	IVU	Ultrasound
• First imaging modality • Cheap. • Useful foi radio-opaque (white) stones. x- iay is the basic modality in the beginning. "KUB" is X-ray of kidney, ureter, and bladder.	• Conventional x-iay + IV contrast • Cheap. • Useful foi radio-opaque stones Contrast is injected through a vein then is mainly excreted via a kidneys and urinary system.	• Used for stones , hydronephrosis,and focal lesions. • Indicated in pregnancy • Contrast between tissue is determined by sound ieflection. IMPORTANT: doesn't provide functional evaluation. it's good for anatomical evaluation.
Computer tomography	**MRI**	**Scintigraphy**
• More precise. • Costly. • +/- contiast. • Useful for trauma, stone, tumoi and infection. Usually CT of kidneys is without contrast • Cross sectional images.. • Bettei evaluation of soft tissue. • It's the best modality for assessing Renal function+anatomy.	• Bettei evaluation of soft tissue. • Uses magnetic field (No Radiation). • Expensive. • Useful foi soft tissue pathology: tumoi, infection • Used foi more specification. • We rarely use MRI for urinary system..	• Utilizes a gamma camera and radioactive isotopes. • Functional test. • Less expensive. • Useful foi: obstruction and **split function** If we want to assess the function of each kidney (separately) we use nuclear medicine because it assess "split function" of each kidney separately

Summary

Conditions associated with enlarged kidneys

Always unilateral

1. Compensatory hypertrophy.

Always bilateral

1. Renal vein thrombosis
2. Polycystic disease
3. Acute glomerulonephritis
4. Amyloidosis

unilateral or bilateral

1. Bifid collecting system
2. Renal mass
3. Hydronephrosis
4. Lymphomatous infiltration

Conditions associated with small kidneys

Always bilateral

- Radiation nephritis
- Chronic glomerulonephritis of many types
- Hypertensive nephropathy
- Diabetes mellitus
- Collagen vascular disease
- Analgesic nephropathy

unilateral maybe bilateral

- Chronic pyelonephritis
- Tuberculosis
- Obstructive atrophy
- Renal artery stenosis or occlusion
- Hypoplasia

Special thanks for 38 & 39 teams

Quiz

1-Imaging Modality Used for stones , hydronephrosis,and focal lesions?

a. Plain X-Ray
b. Ultrasound
c. Computed Tomography
d. Intravenous Urogram(IVU)
e. Magnetic Resonance Imaging

2-one of the most common sites of renal stones is?

a. mid ureter
b. ureteropelvic junction
c. junction of mid-distal ureter
d. proximal ureter

3-Conditions associated with enlarged kidneys and always unilateral?

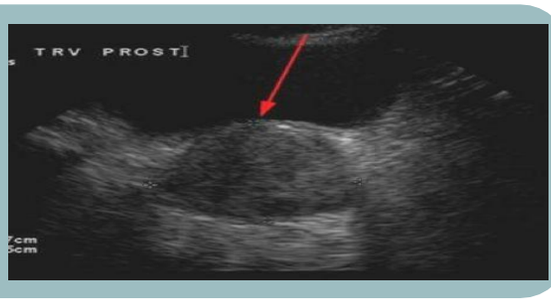
a. Renal mass
b. Compensatory hypertrophy.
c. Tuberculosis
d. Amyloidosis

4- which one is not a very good modality for prostate?

a. CT
b. MRI
c. US
d. All of the above are considered good

5 what does the red arrow indicate?

a. Posterior wall of the urinary bladder
b. Prostate that is enlarged
c. Normal male prostate
d. Anterior wall of urinary bladder



6identify the abnormality circled in red and the modality used?

a. Tumor of the prostate,MRI
b. BPH,MRI
c. Tumor of the prostate,US
d. BPH,US

Dr's questions:

7- Which modalities use ionizing radiation?

a. IVU, MRI, CT
b. X-ray, CT, MRI
c. IVU, CT, X-ray
d. Only X-ray

8- Which modalities are portable?

a. US
b. MRI
c. X-ray
d. a & c

9-Which modalities are used for assessing kidney function?

a. MRI
b. IVU
c. Nuclear
d. Contrast CT
e. b,c,d

Answers
1)B
2)B
3)B
4)A
5)B
6)C
7)C
8)D
9)E