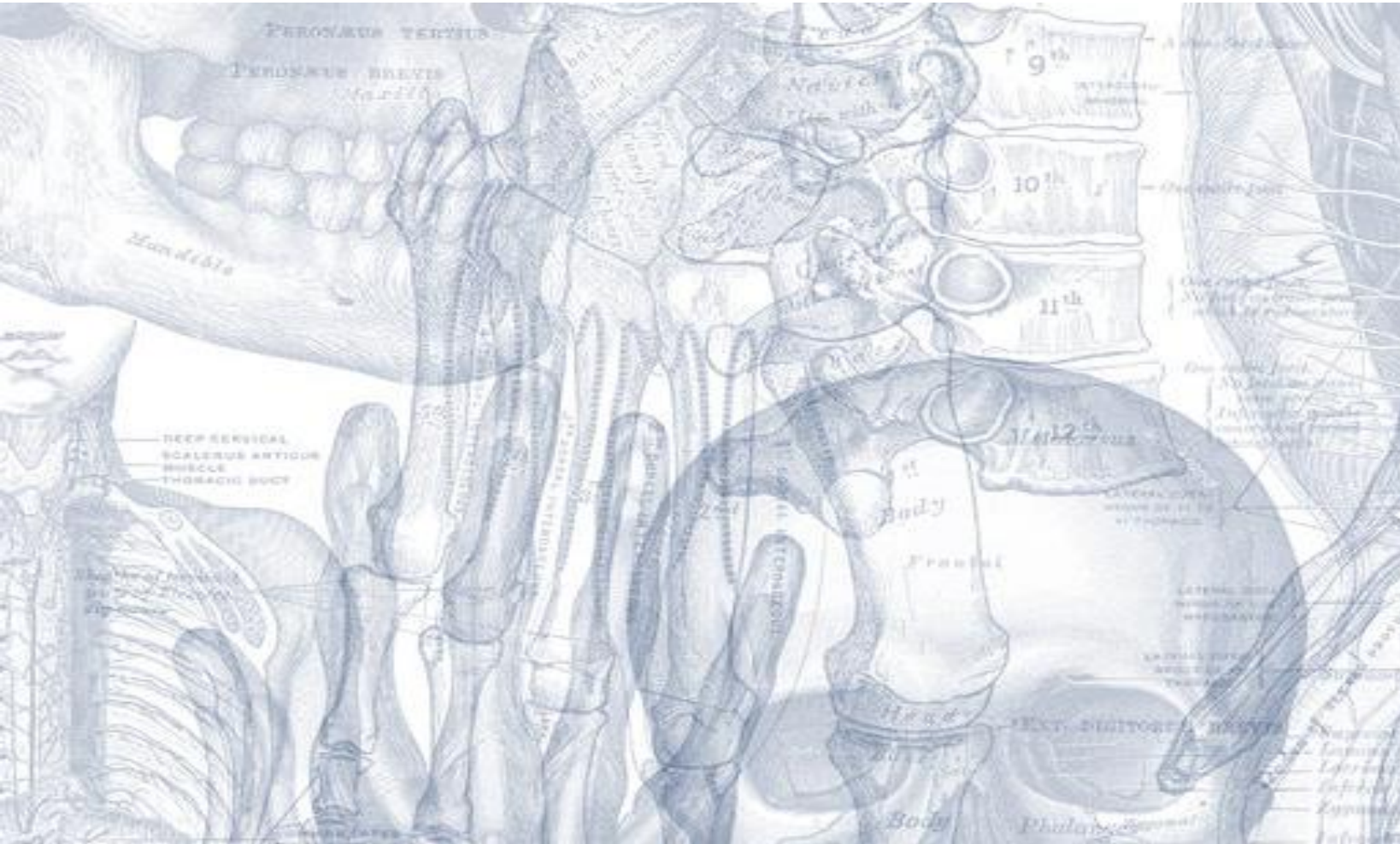


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Radiology of the Renal System

Please view our [Editing File](#) before studying this lecture to check for any changes.

Color Code

- **Important**
- **Doctors Notes**
- **Notes/Extra explanation**

Objectives

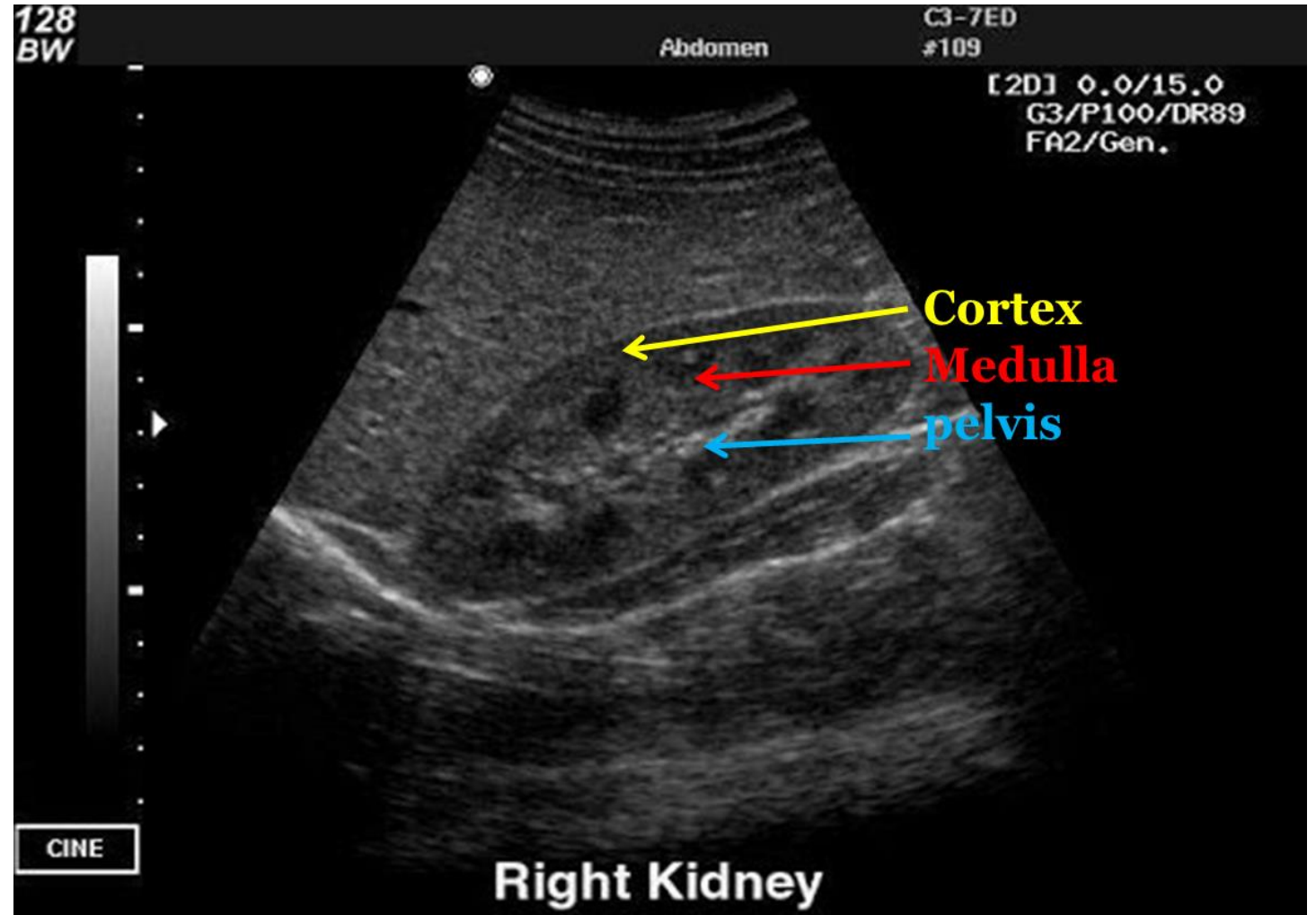
- ✓ Modality used for assessment of the urinary system
 - X-ray
 - US
 - CT
 - MRI
 - Nuclear
- ✓ Normal anatomy
- ✓ Common pathologies
 - Kidney
 - Ureter
 - Bladder
 - Urethra

This lecture is included in the **MCQ** exam only

Modalities used:

US (Ultra Sound)

Pros	
1. No ionizing radiation	
2. Inexpensive	
3. Portable	
Cons	
1. Operator dependent	
2. Time consuming	
Image Key:	
White	Stones and calcification
Grey	Soft tissue
Black	Fluid



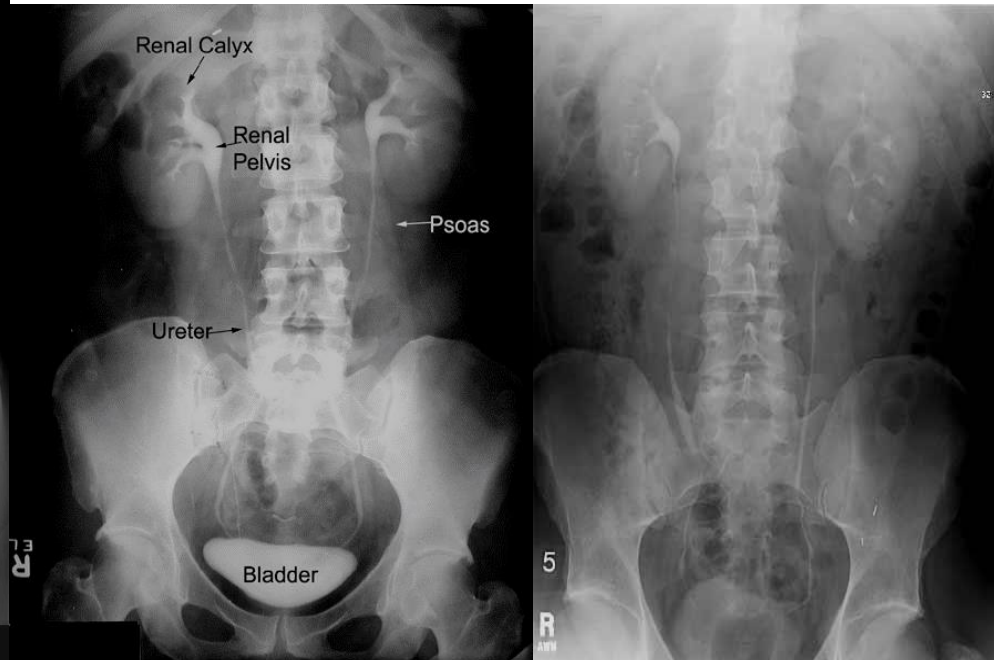
Modalities used:

X-Ray

Pros	
1. Inexpensive	
2. Quick	
Cons	
1. Ionizing radiation	
2. Not definitive	
Image Key:	
White	Bones and calcification
Grey	Soft tissue
Black	Air



IVP (intravenous pyelogram):
injecting the patient with a contrast
(صبغة) intravenously

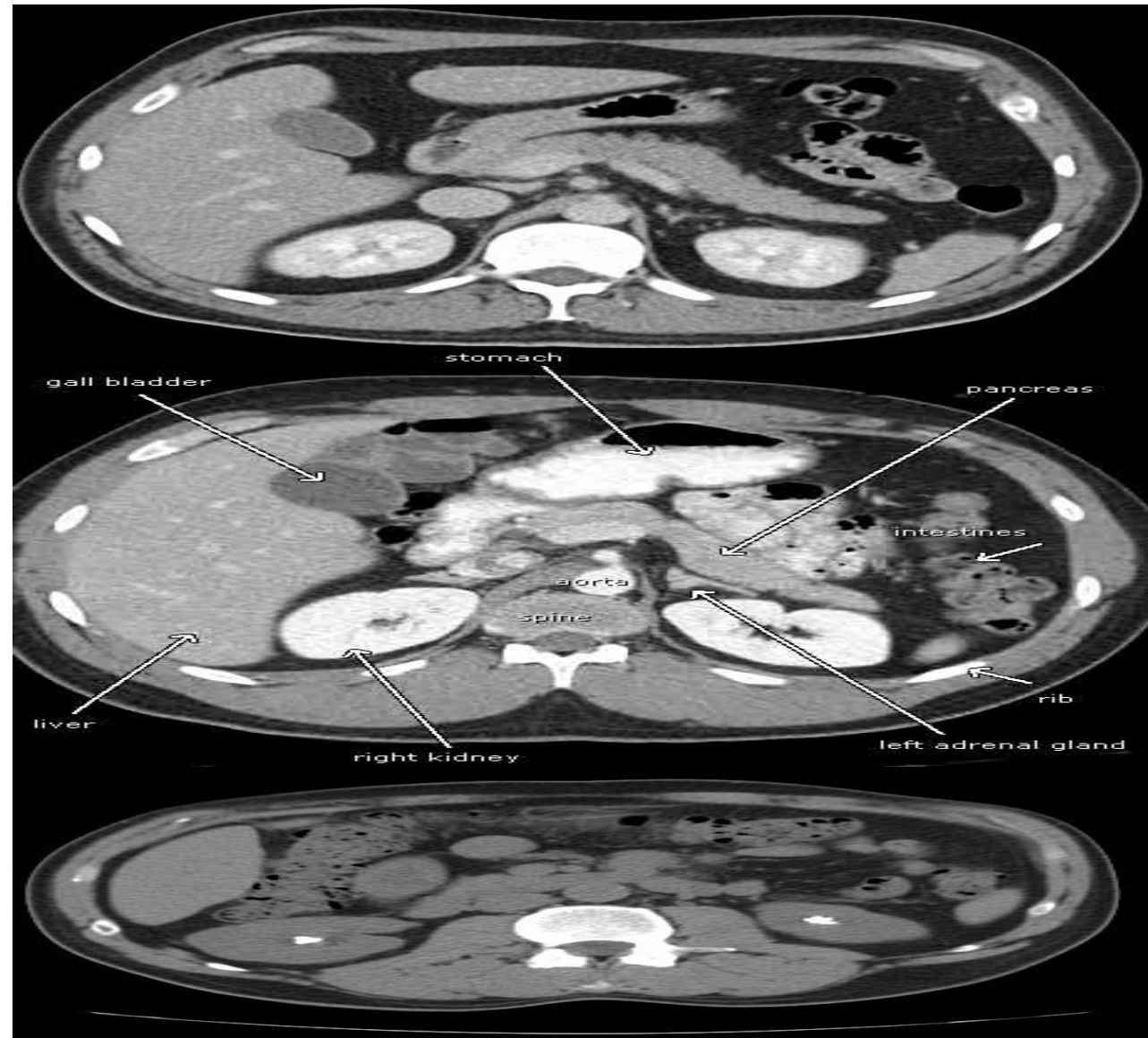


Modalities used:

CT

Pros	
1. Quick 2. A lot of information	
Cons	
1. Ionizing radiation 2. Expensive	
Image Key:	
White	Bones and calcification
Grey	Soft tissue
Black	Air

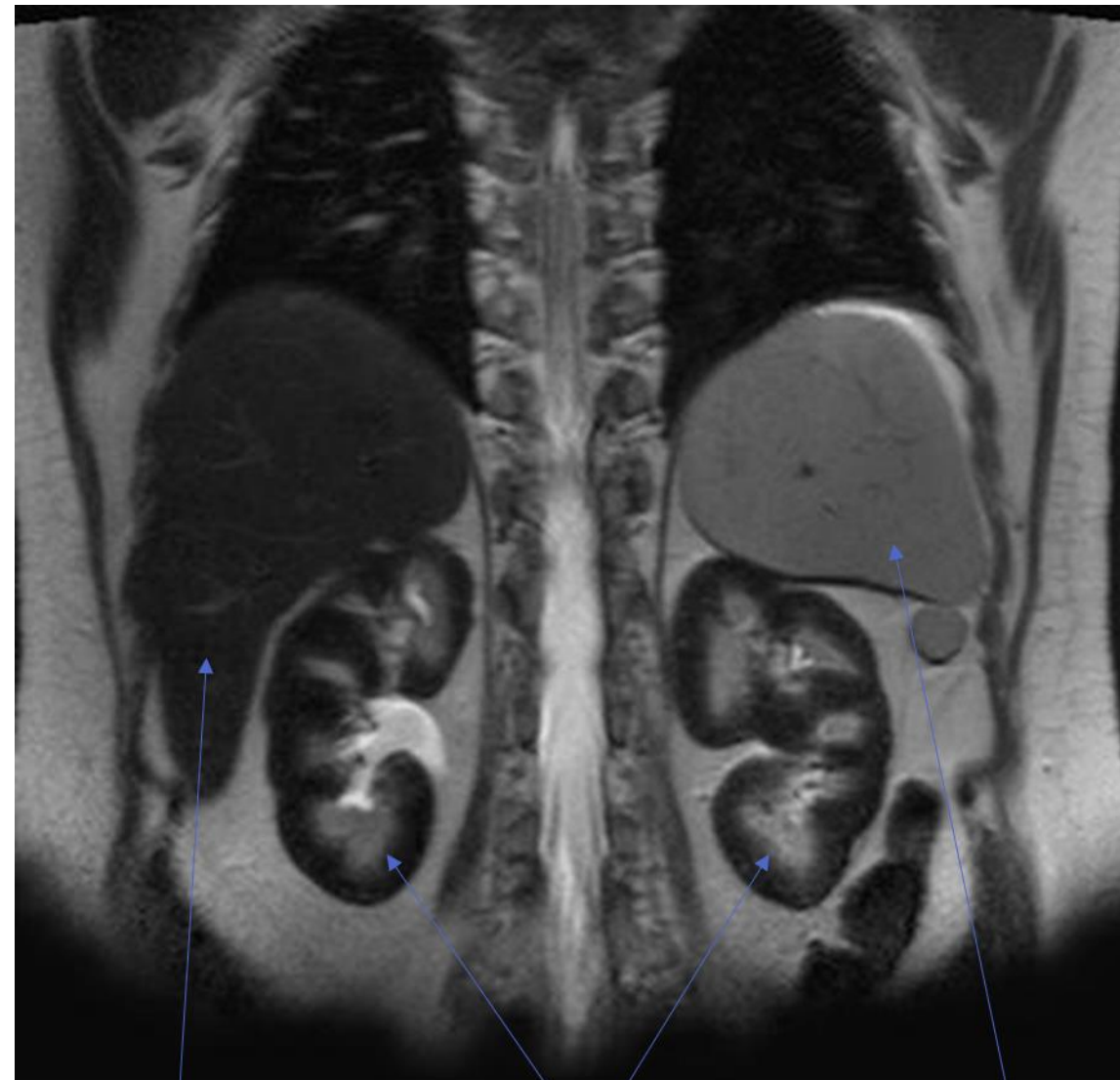
The best modality for diagnosis of renal stones is non-contrast CT
(the contrast will hide the stone)



Modalities used:

MRI

Pros	
1. No ionizing radiation 2. A lot of information	
Cons	
1. Expensive 2. Time consuming	
Image Key:	
White	High intensity
Grey to Black	Low Intensity



Liver

Kidney

Spleen

Modalities used:

Nuclear Scans

Pros
1. Asses the <u>function</u> .
Cons
1. Time consuming
2. Radioactive materials

The previous modalities were used to asses the anatomy of the renal system whereas the nuclear scan assesses the **function**.

Nuclear medicine imaging uses small amounts of radioactive materials called radiotracers that are typically injected into the bloodstream. They travel through the area being examined and gives off energy in the form of gamma rays which are detected by a special camera.

Note: Unlike other modalities in nuclear scans the right and left are not opposite. So your right is right an left is left.



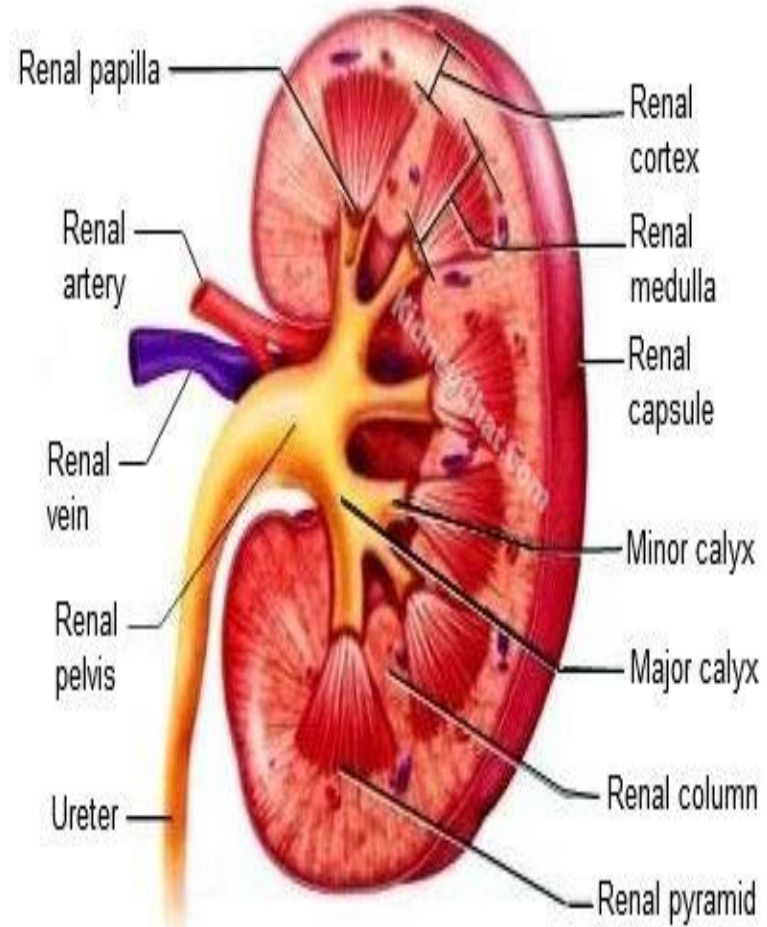
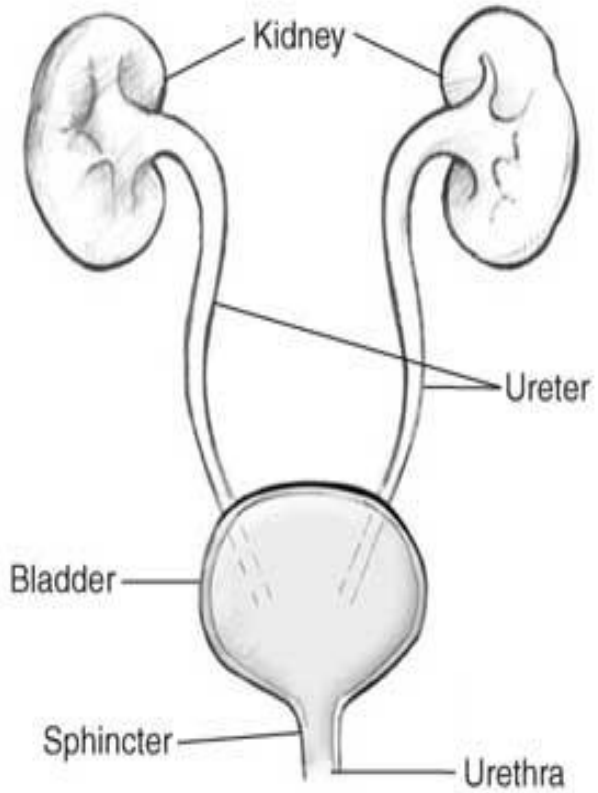
*the left kidney is not functioning well as the right one because it was unable to excrete all the urine and material.

SUMMARY

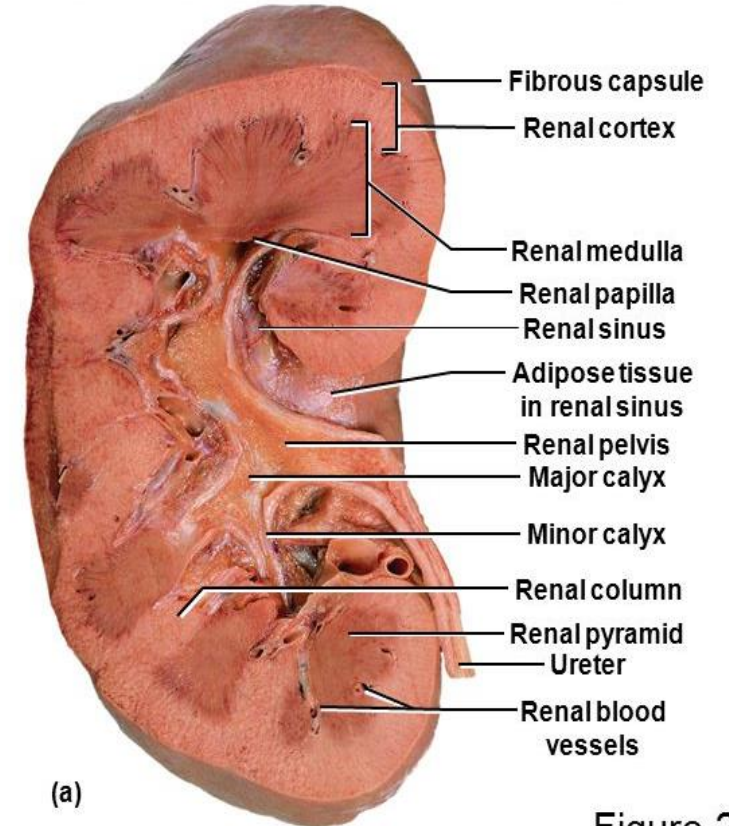
modality	US	X-ray	CT	MRI	Nuclear
Pros	<ul style="list-style-type: none"> No Ionized radiation. Cheep. Portable. 	<ul style="list-style-type: none"> Cheep. Quick. 	<ul style="list-style-type: none"> Quick. Gives lots of information. 	<ul style="list-style-type: none"> No Ionized radiation. Gives lots of information. 	<ul style="list-style-type: none"> Assess the function.
Cons	<ul style="list-style-type: none"> Operator dependent. Time consuming. 	<ul style="list-style-type: none"> Ionized radiation. Not defective. 	<ul style="list-style-type: none"> Expensive. Ionized radiation. 	<ul style="list-style-type: none"> Expensive. Time consuming. 	<ul style="list-style-type: none"> Time consuming. Radioactive materials.

Modality	White	Grey	Black
Ultrasound (US)	stones and calcification	soft tissue	fluid
X-Ray	bone and calcification	soft tissue	air
CT	bone and calcification	soft tissue	air
MRI	High intensity	Low intensity	

Anatomy of the Urinary System



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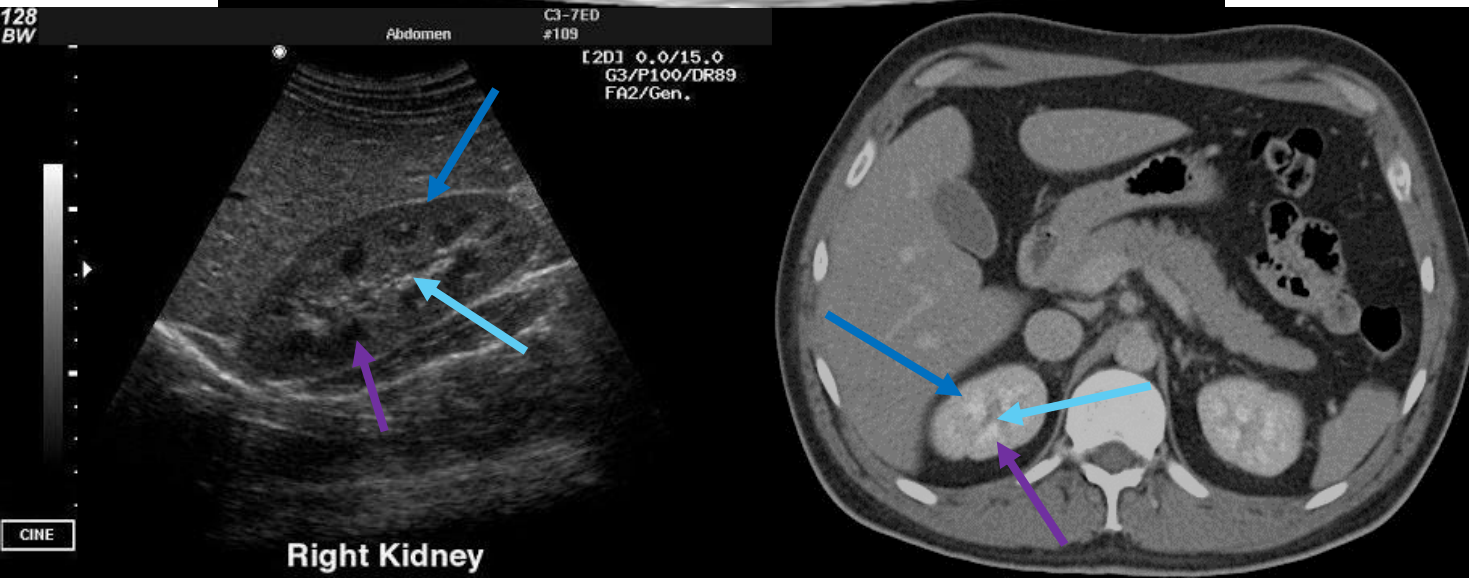
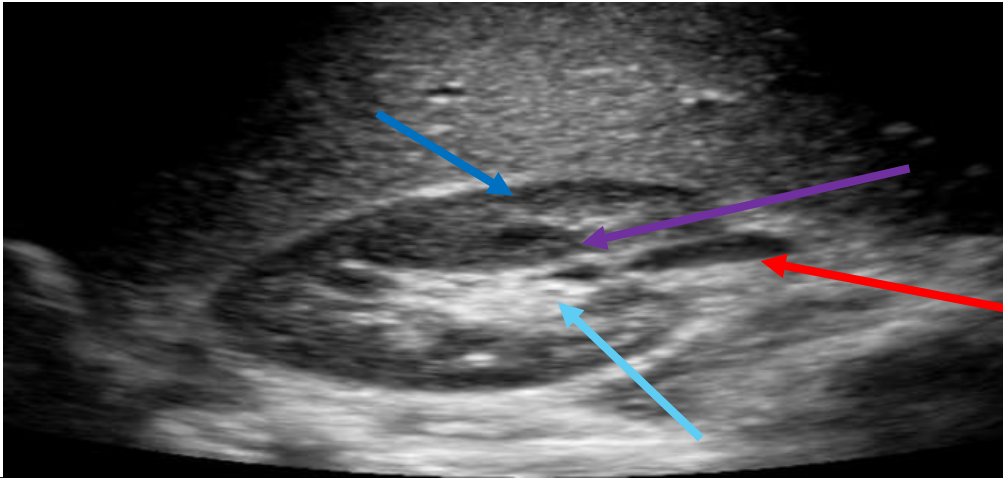
Ralph Hutchings/Visuals Unlimited

Figure 23.4a

Gross Anatomy of the Kidney

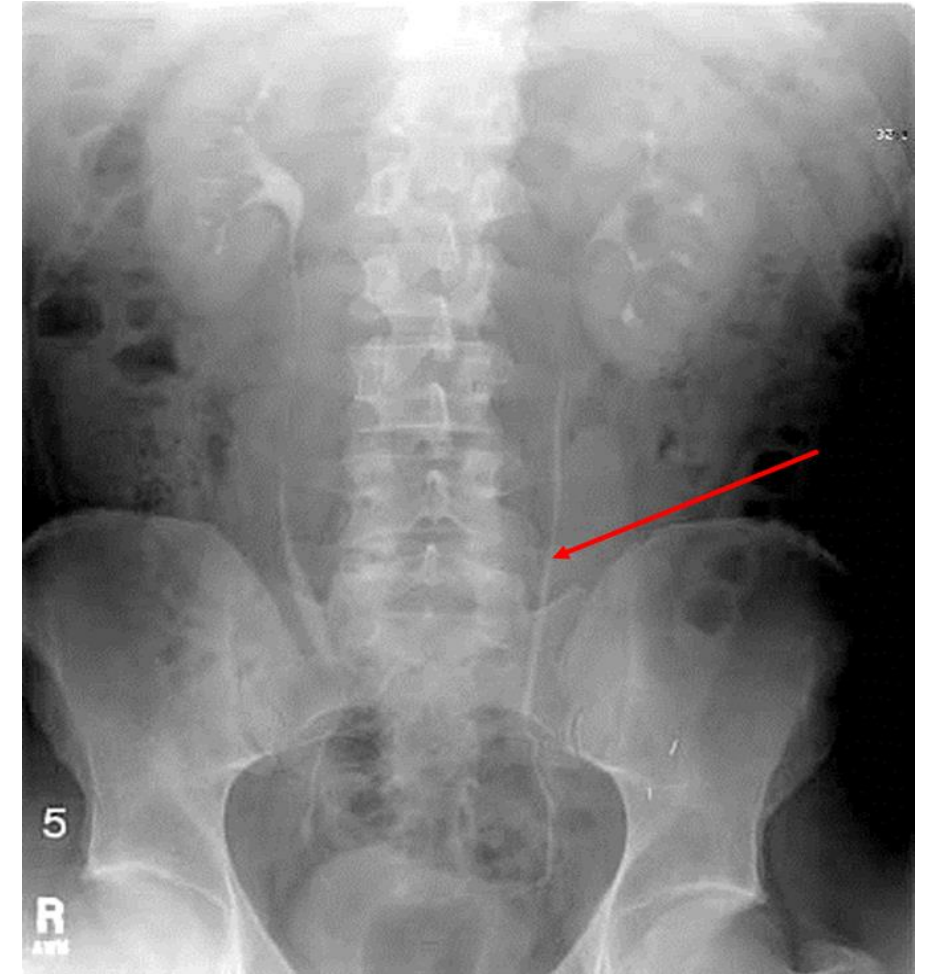
Kidneys

- Cortex
- Medulla
- Renal pelvis
- Ureter

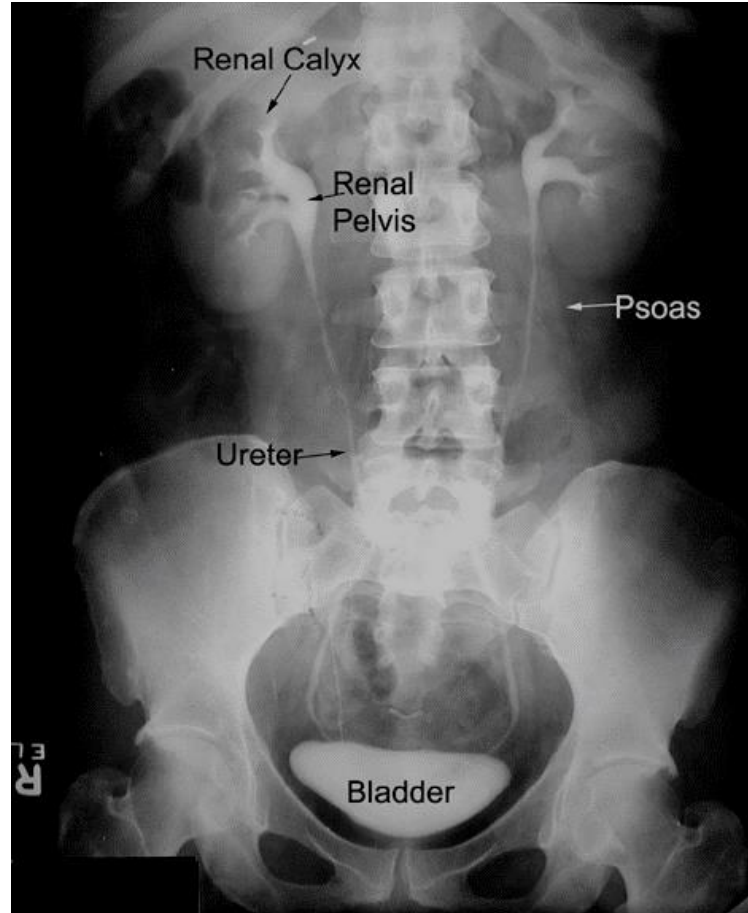


Right Kidney

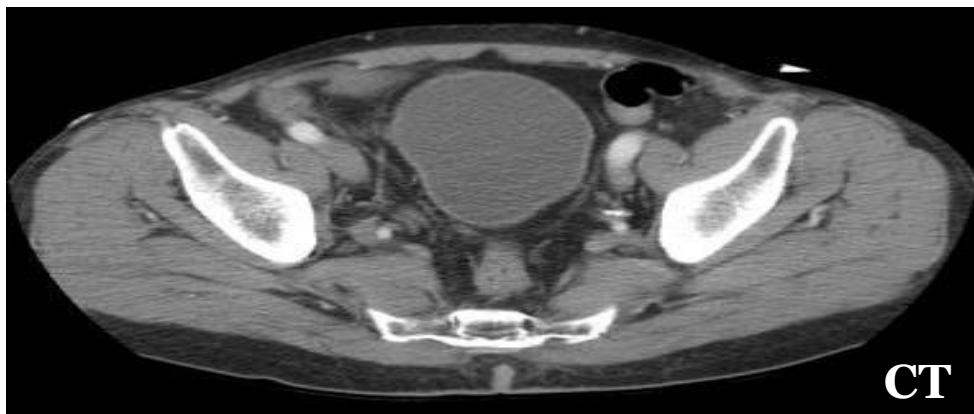
Ureters



Ureters (IVP)

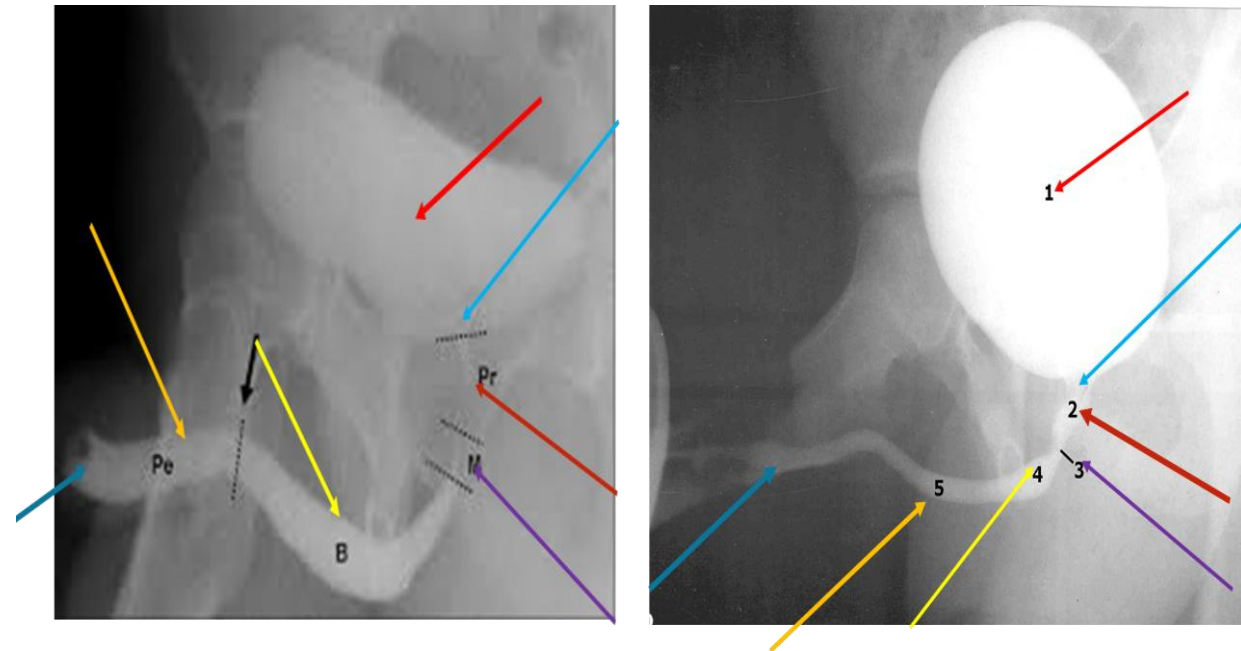


Urinary Bladder



Urethra

- Bladder
- Bladder neck
- Prostatic urethra
- Membranous urethra
- Bulbar urethra
- Penile urethra
- Urethral meatus



*Summery

Common Renal System Pathologies

Kidneys

Cysts

Stones

Pyelonephritis

Hydronephrosis

Renal Artery Thrombosis

Renal Vein Thrombosis

ESRD

Tumor

Congenital

Ureter

Stones

Vesicoureteral reflux disease

Congenital

Bladder

Prostate hypertrophy

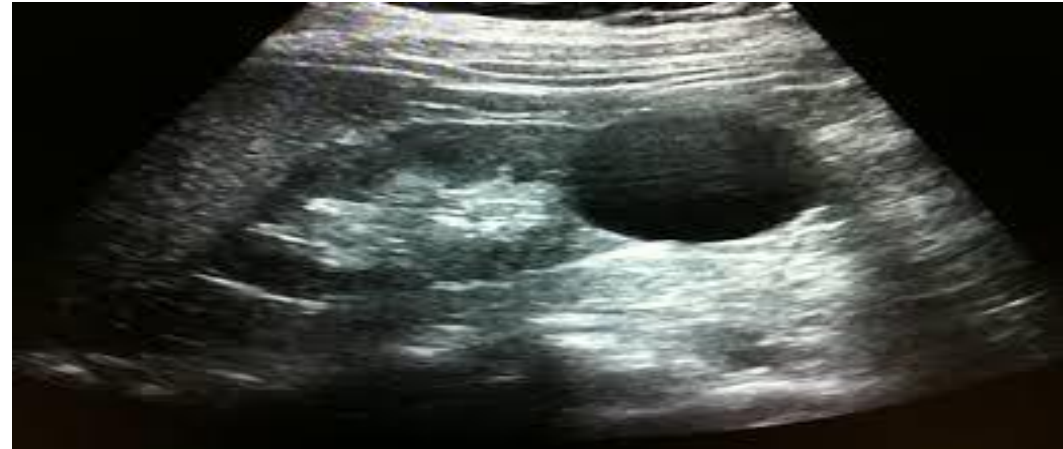
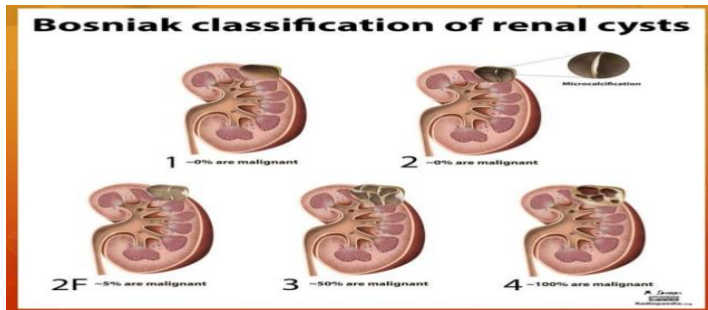
Cystitis

Bladder rupture

Common Kidney Pathologies: Cysts

1. Benign.
2. Common.
3. Bosniak classification*.

*Bosniak classification : it divides renal cystic masses into five categories based on imaging characteristics on contrast-enhanced CT. It's helpful in predicting a risk of malignancy and suggesting either follow up or treatment.



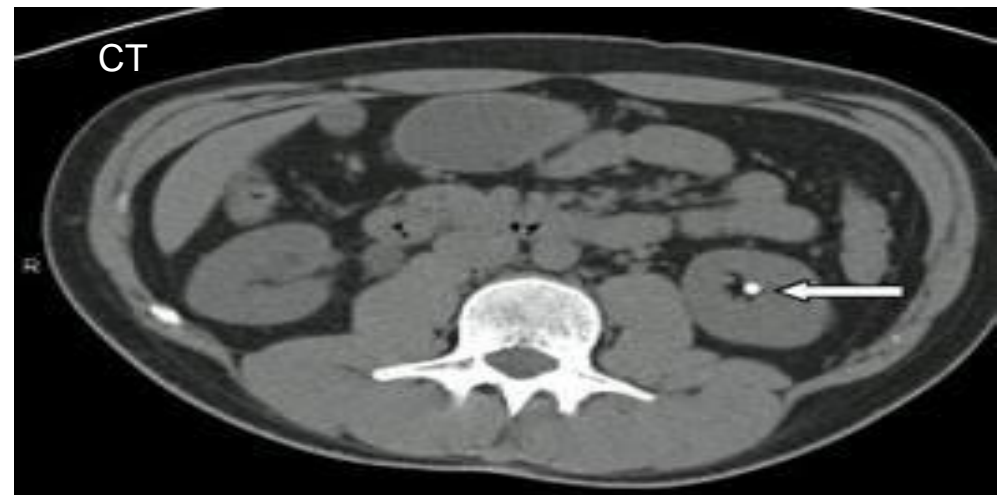
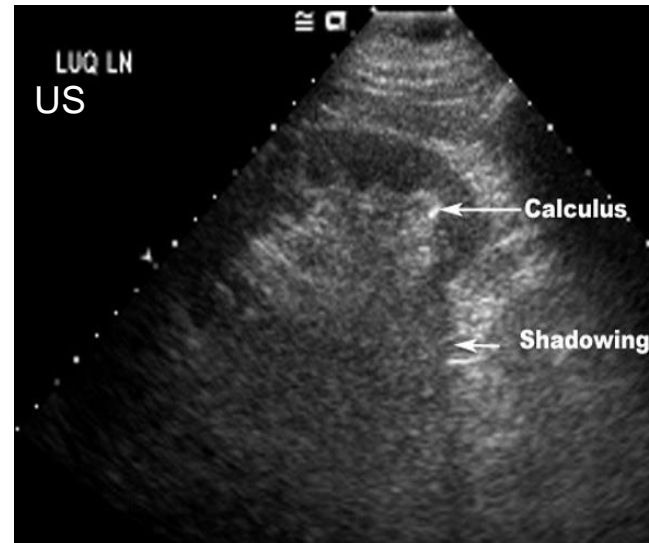
ANECHOIC circular mass , clear borders



Hypo-dense clear border mass in right kidney

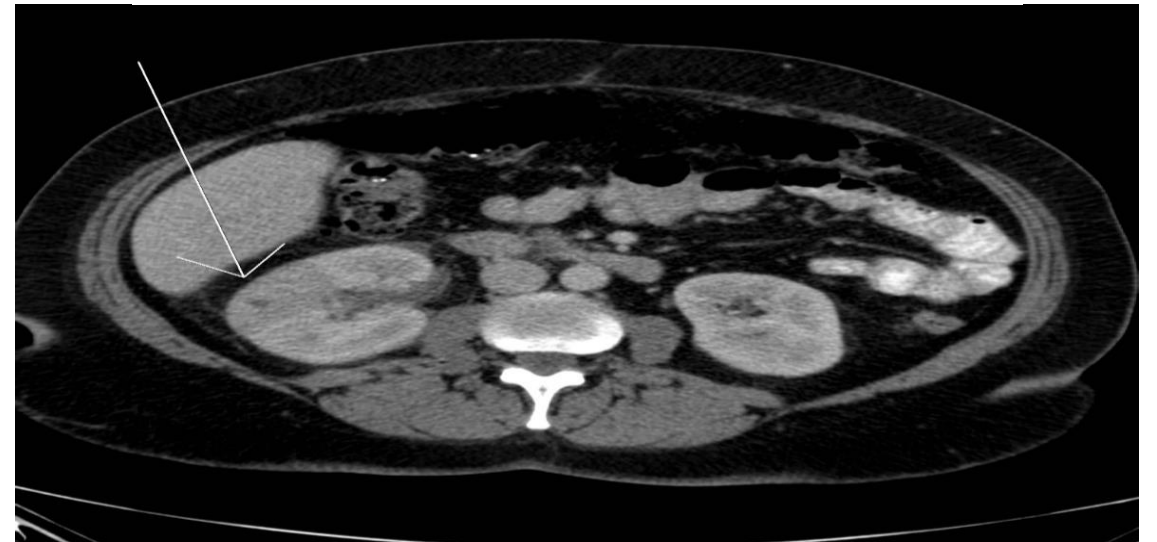
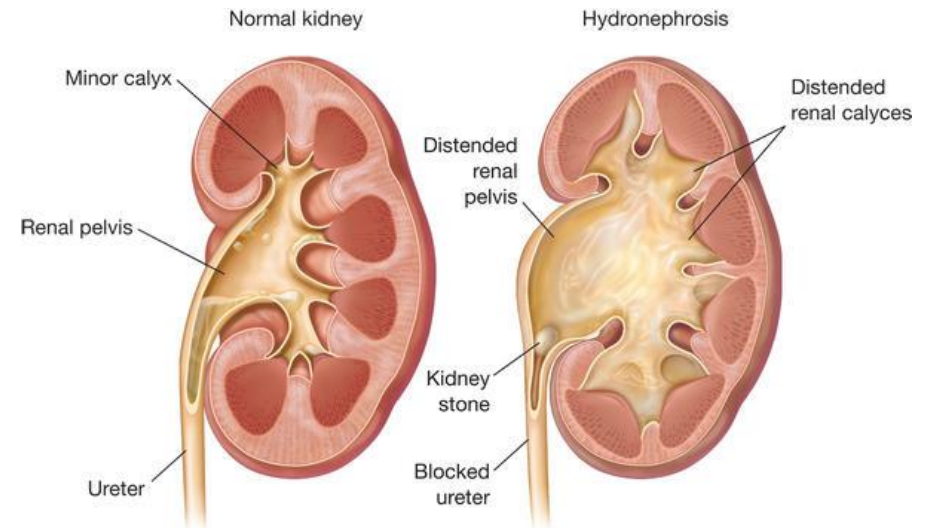
Common Kidney Pathologies: Stones

- **Radio-opaque (calcium , struvite).**
Referring to a material or tissue that blocks passage of X-rays, and has a bone or near-bone density; radiopaque structures are white or nearly white on conventional X-rays, so it appears in imaging.
- **Radio-lucent (uric acid , cysteine).**
materials that allow x-rays to penetrate with a minimum of absorption, so it doesn't appear in imaging.



Common Kidney Pathologies: Pyelonephrosis

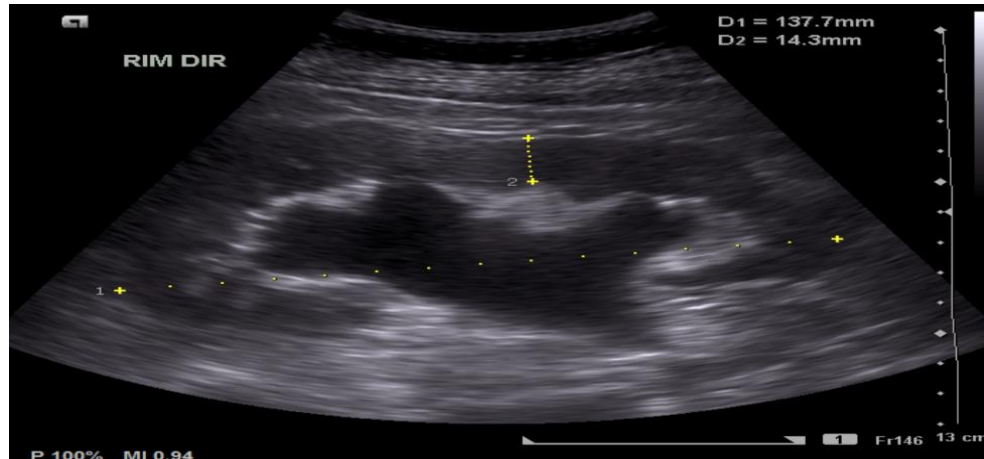
- is the infection of the kidney.
- Acute pyelonephritis results from bacterial invasion of the renal parenchyma. Bacteria usually reach the kidney by ascending from the lower urinary tract.
- CT scan for a patient with pyelonephritis, we do it only if the patient doesn't respond to the treatment or he had a recurrent pyelonephritis.



Common Kidney Pathologies:

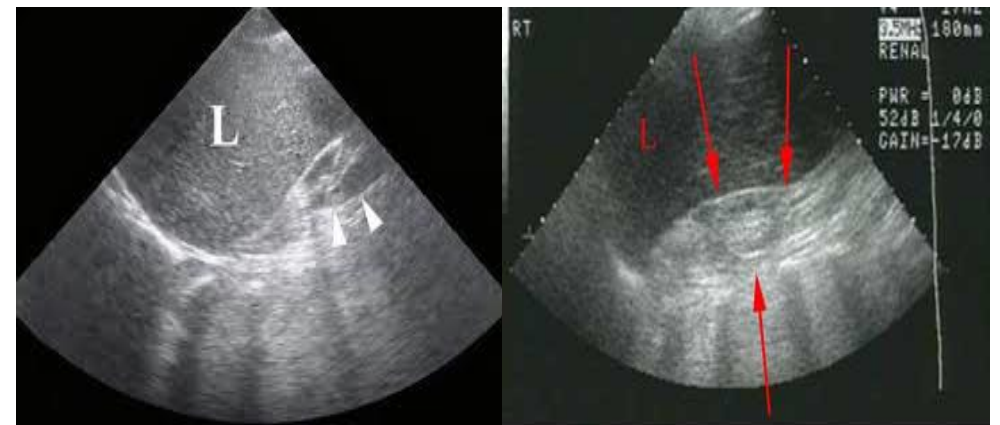
Hydronephrosis

is a condition that typically occurs when the kidney swells due to the failure of normal drainage of urine from the kidney to the bladder.



ESRD (End Stage Renal Disease)

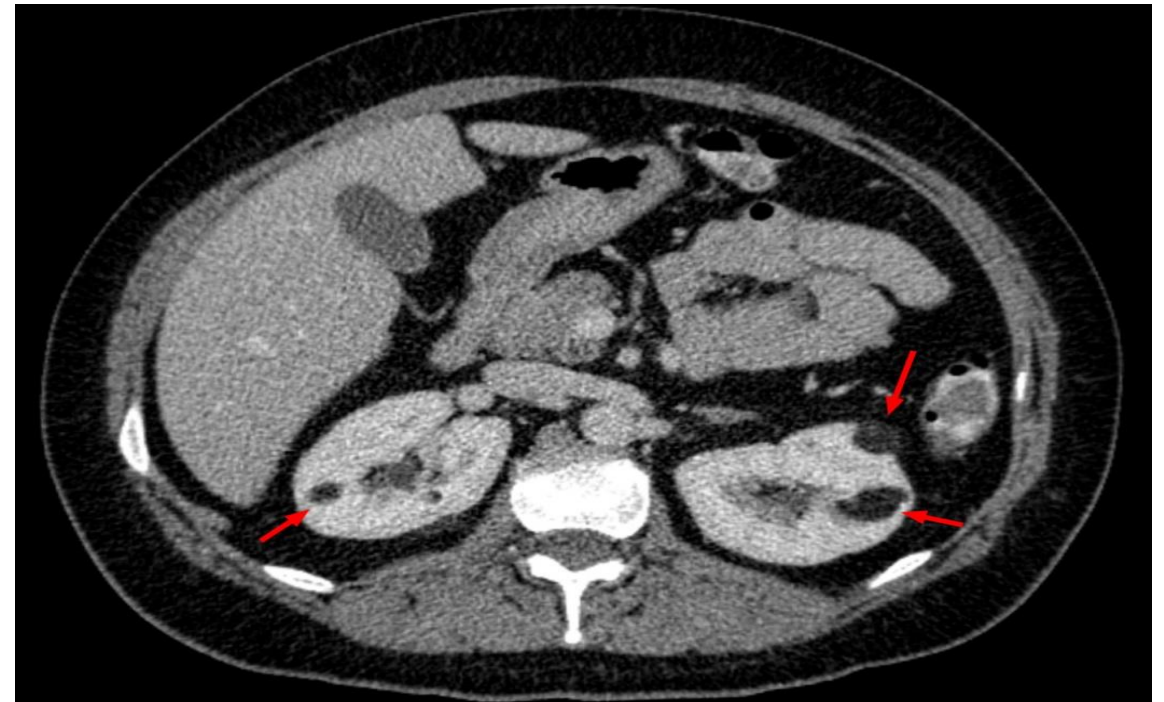
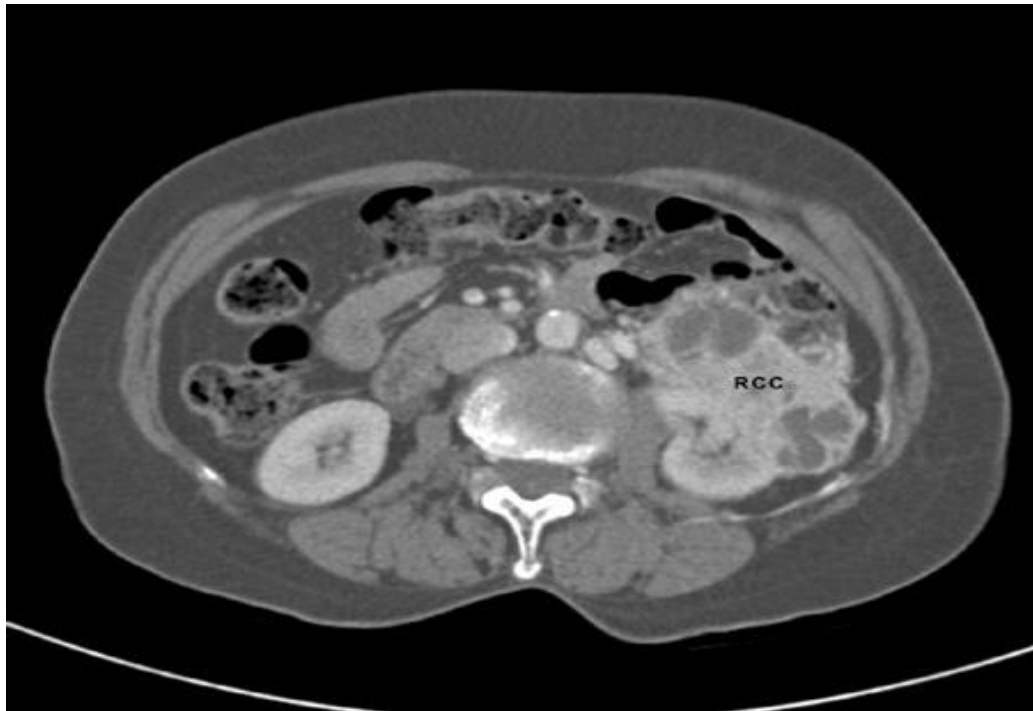
Kidney failure, also called end-stage renal disease (ESRD), is the last stage of chronic kidney disease. The kidney undergoes atrophy



Common Kidney Pathologies:

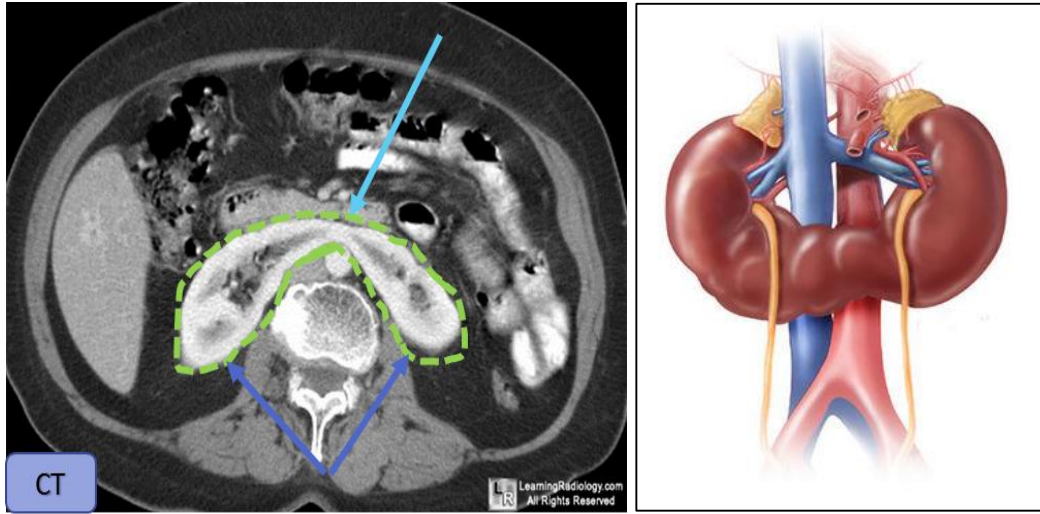
Tumors

- **Benign:** most common benign is angiomyolipoma.
- **Malignant:** most common type is renal cell carcinoma.



Common Kidney Pathologies:

Congenital

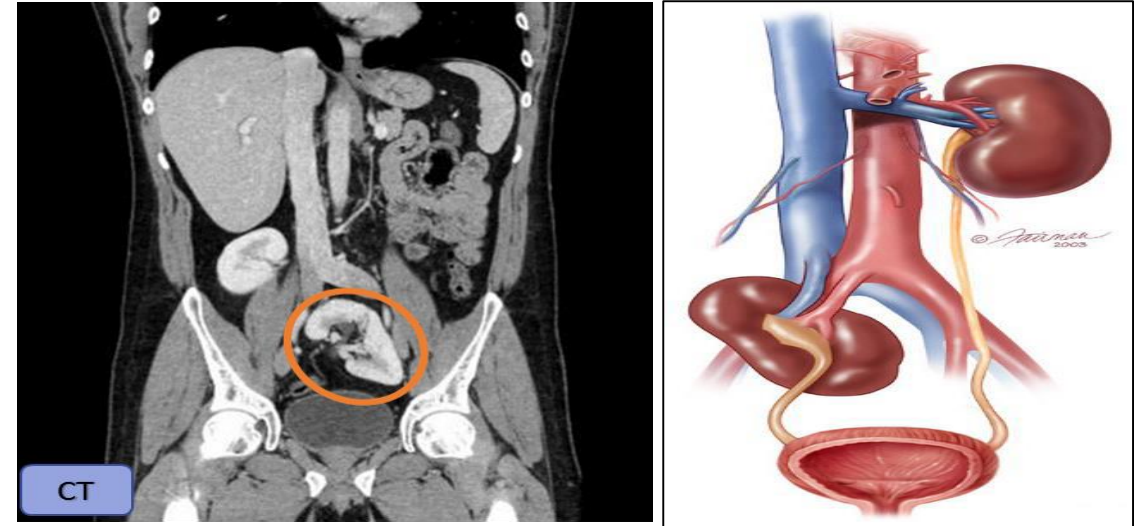


Lower pole of kidneys, Upper poles of kidneys, Horseshoe kidney

1- Horseshoe Kidney:

The kidneys are fused together from their lower pole.

- As the kidneys develop in the pelvis, they may fuse together at their lower pole.
- As they ascend, they pass by the inferior mesenteric artery, which can act as an obstacle, causing them to be lower than normal.
- Usually asymptomatic, no intervention is needed.
- Affects about 1 in 400 people.
- Patient lives normally, but is more prone to infections.



2- Ectopic Kidney:

It is when a kidney fails to completely ascend and is left in the pelvic region.

- Patients live normally
- It has an abnormal orientation. Therefore they may form kidney stones or infections more than others.

Common Kidney Pathologies: Congenital

3-Polycystic Kidney Disease (PKD)

It is a genetic disorder, in which abnormal cysts (fluid filled sacs) develop in the kidneys, causing the kidneys to become non functional.

Two types:

- Autosomal dominant polycystic kidney disease (ADPKD). symptoms usually appear in adulthood.
- Autosomal recessive polycystic kidney disease (ARPKD). symptoms usually manifest in infancy.

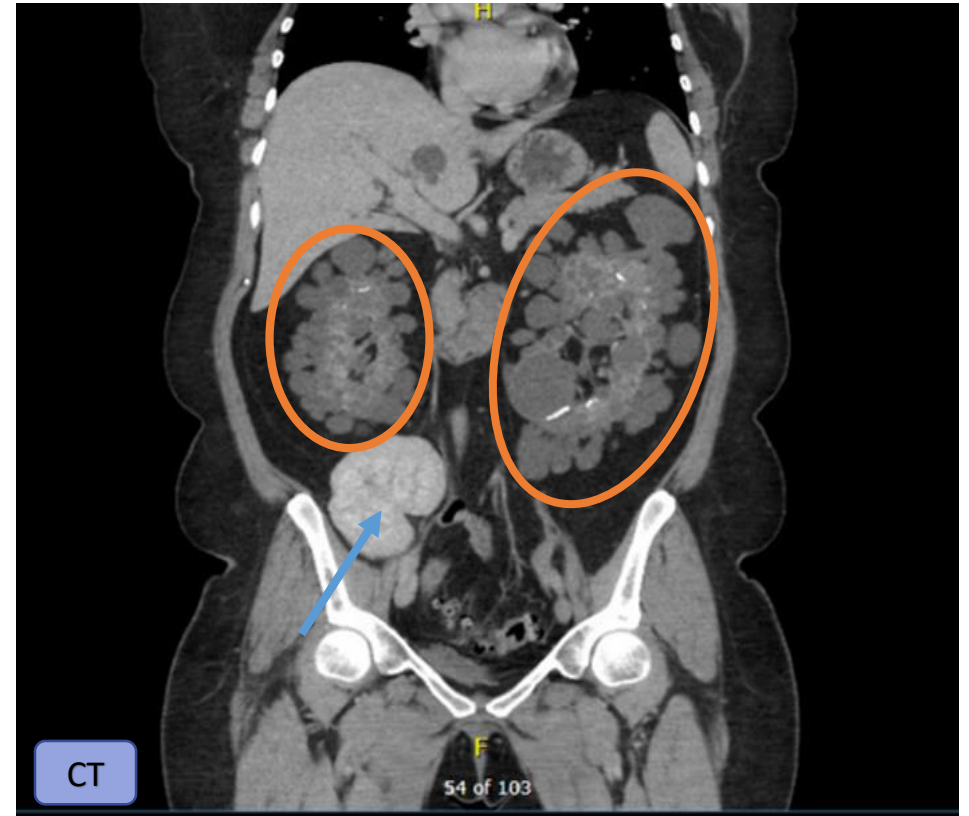
The original kidneys are not removed from the body.

Why? Because we are trying to minimize unnecessary surgical procedures.

Extra information:

Hyper-dense/intense: appears lighter

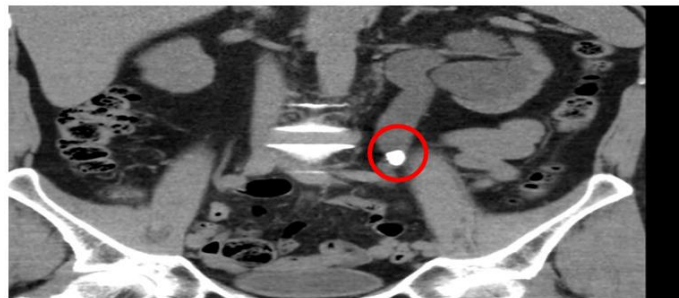
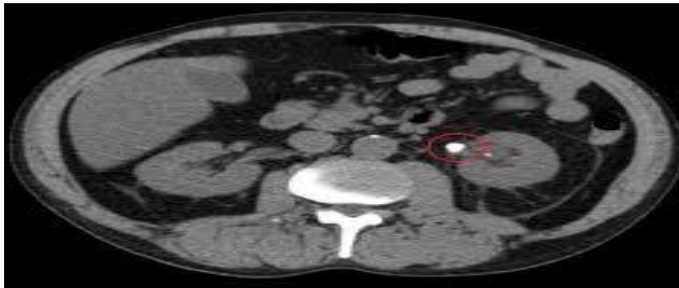
Hypo-dense/intense: appears darker



Common Ureter Pathologies:

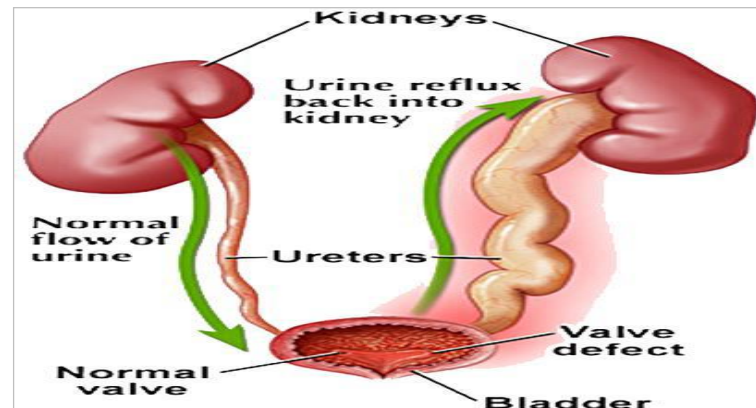
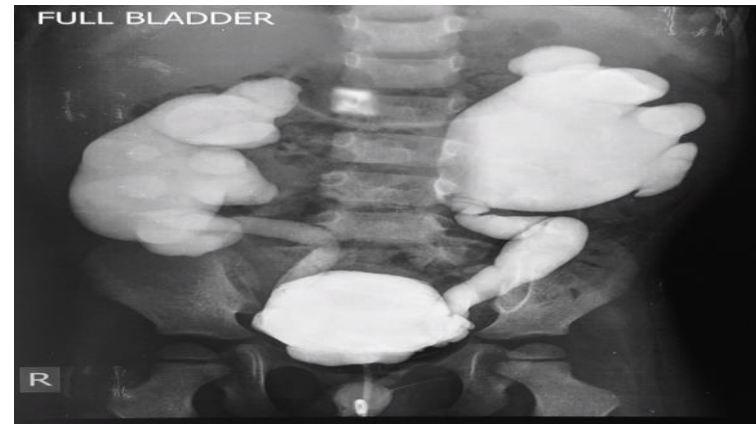
1- Ureteric Stone:

stones in the ureter will make an obstruction and block the urine's way to the bladder, which may cause Hydronephrosis.



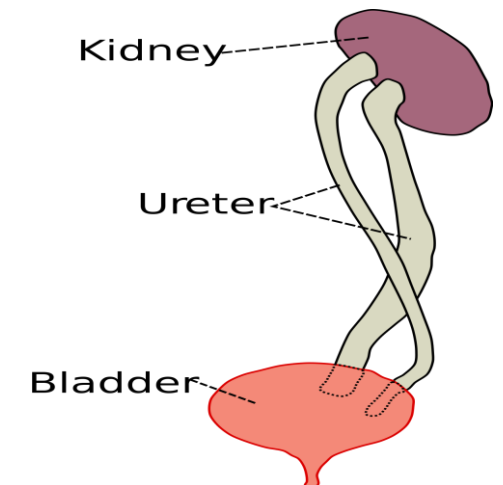
2- Vesicoureteral reflux disease

the backward flow of urine from the bladder into the kidneys. It may be caused by an obstruction or Insufficient submucosal length of the ureter entering the bladder (normal = 3/4 inch). From anatomy



3- Duplicating Collecting System

It is the most common renal abnormality, occurring in approximately 1% of the population.



Common Urinary Bladder Pathologies: Cystitis

IMPORTANT!

Image 1:

an inflamed urinary bladder (thick surrounding walls)

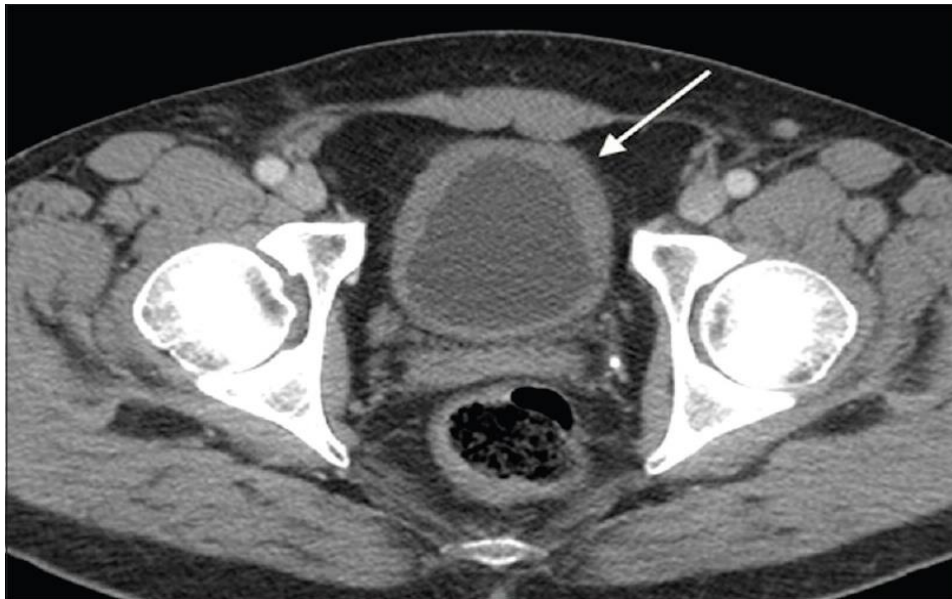
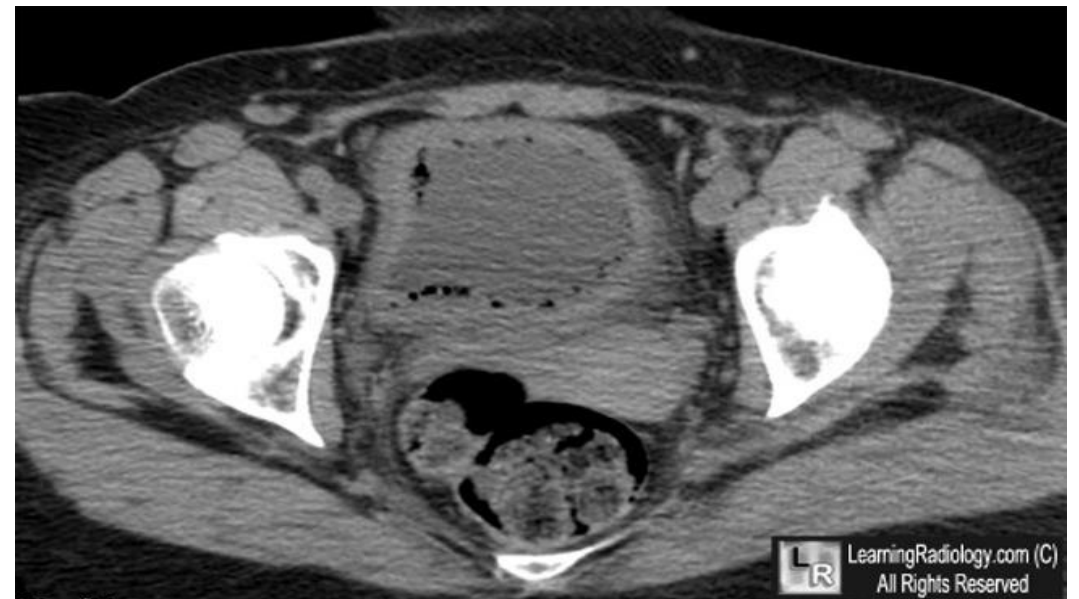


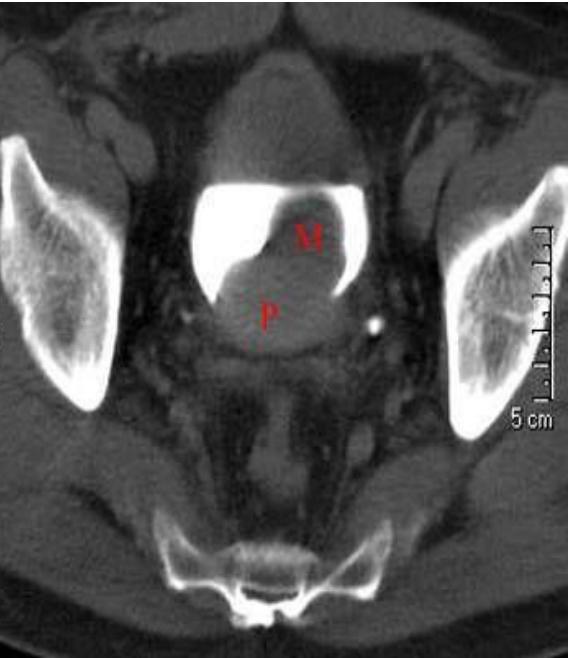
Image 2:

This bladder has gas bubbles that could be due to inflammation or infection from ‘gas producing’ bacteria



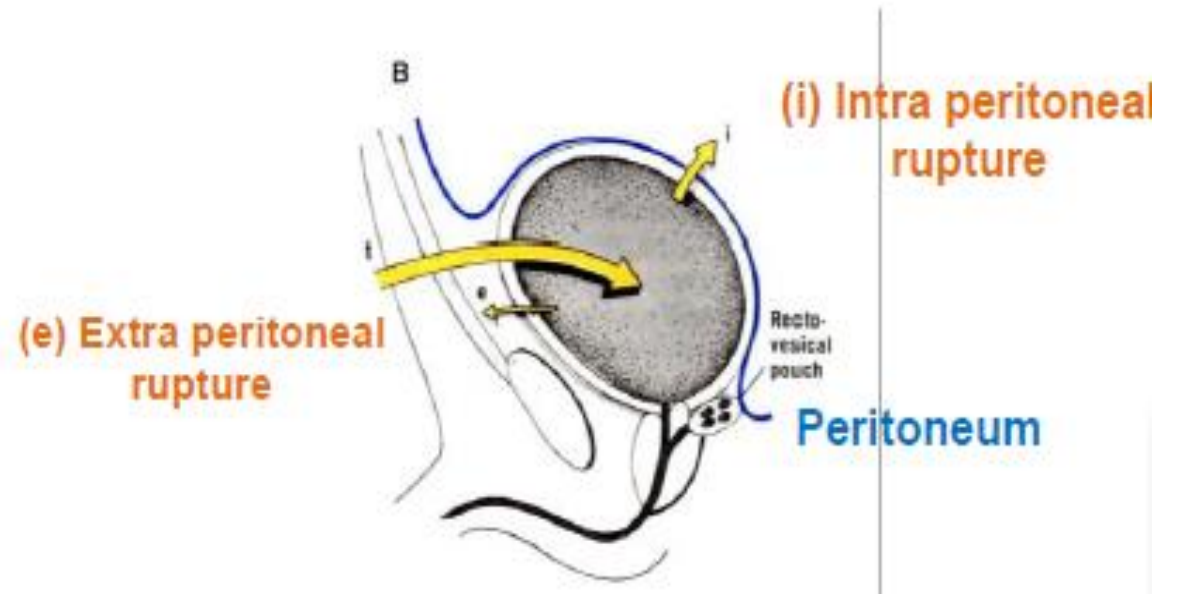
Common Urinary Bladder Pathologies:

Benign Prostate Hypertrophy



Bladder rupture:

- The abdomen is lined with the peritoneum from inside.
- The bladder is located below the membrane of the peritoneum

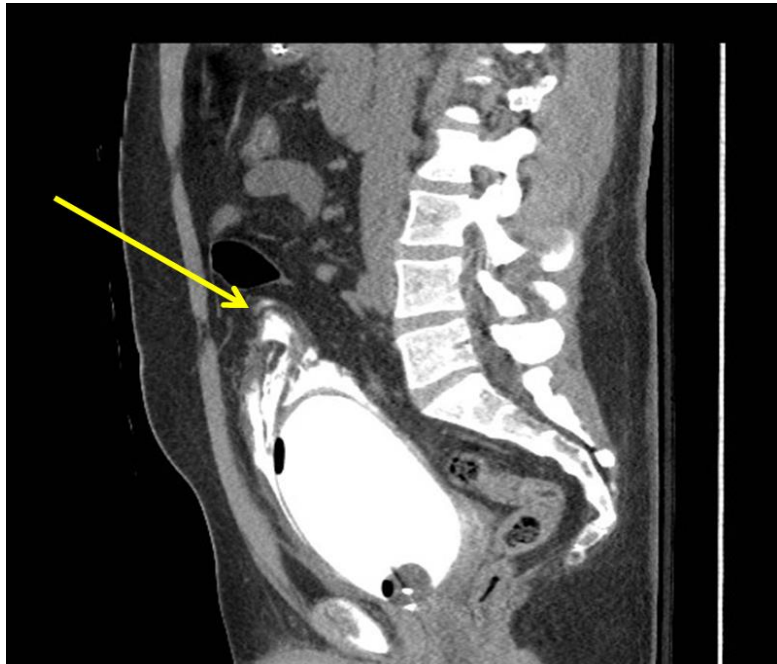


Common Urinary Bladder Pathologies:

Bladder Rupture (cont..)

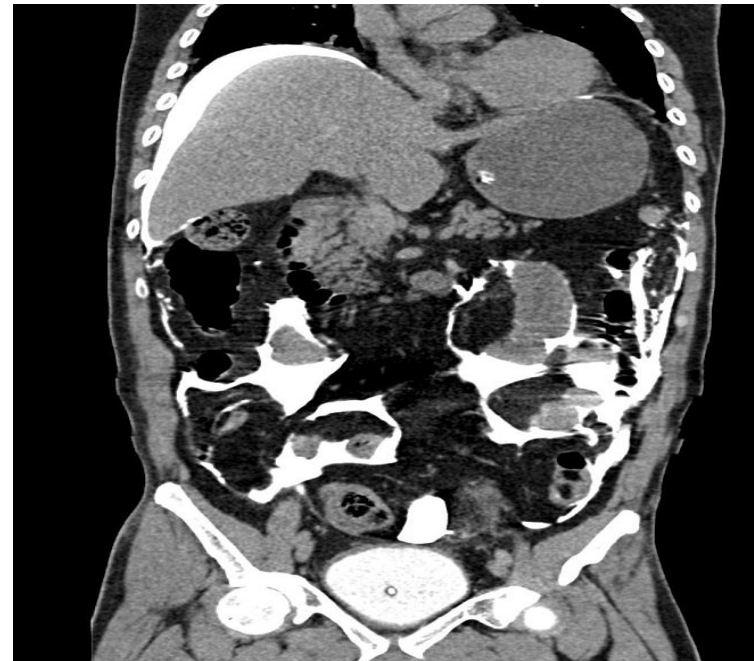
Extra Peritoneum:

any rupture or leakage to the content of the bladder does not enter the peritoneum. Patient does not need surgery.



Intra Peritoneum:

there is a rupture in both bladder and peritoneum. In this case, patient will need surgery.



** Online Quiz **

<https://www.onlinequizcreator.com/radiology-of-the-renal-system/quiz-275250>



Leaders:

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Jawaher Abanumy

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Abdullah jammah
Abdullah Alhashem
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