431
Radiology Team

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Lecture 1: Introduction to Radiology

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◆Important ◆Doctor's notes ◆Team's notes

We thank 430 Team for their helpful notes

1) Theoretical Part:

1) X-ray:

Electromagnetic radiation causing ionization in the body.

◆X-rays are absorbed to a variable extent as they pass through the body. The visibility of both normal structures and disease depends on this differential absorption. With conventional radiography there are four basic densities – gas, fat, all other soft tissues and calcified structures.

Structure	Appearance
Air	X-rays that pass through **air** are least absorbed (least atomic number) -> cause **the most blackening** of the radiograph (it's translucent)
Bones and other calcified structures	Calcium absorbs the most and -> virtually **white**
Soft tissue (except fat)	Various shades of **grey**, depending on how dense they are.
◆Fat	Absorbs slightly fewer x-rays and -> appears **a little blacker than the other soft tissues.**
Ligament	Won't appear
◆Black coloration is called lucency & white coloration is called opacity	

◆The path of the x-ray beam usually describes projections. Thus, the term poster anterior (PA) view designates that the beam passes from the back to the front, the standard projection for a routine chest film.
The other two are: anterior posterior (AP) and lateral

◆The image on an x-ray film is 2-dimensional. All the structures along the path of the beam are projected on the same portion of the film. Therefore, it is often necessary to take at least 2 views to gain information about the 3rd dimension.

For further information:
http://www.radiologymasterclass.co.uk/tutorials/chest/chest_quality/chest_xray_quality_projection.html

Contrast study: (N.B. Contrast is radio-opaque)

Oral Contrast		IV Contrast
Barium swallow (Esophagography)	To examine the upper gastrointestinal (GI) tract.	Angiogram (Arteriography): A medical imaging technique used to visualize the inside (lumen) of blood vessels.
Barium meal (Upper gastrointestinal series)	To examine the esophagus, stomach and duodenum.	
Barium enema	Lower gastrointestinal (GI) examination; colon	

Pneumothorax	Abnormal collection of air or gas in the pleural space that separates the lung from the chest wall. It is often seen on X-ray, but small amounts are often missed, and CT is needed.
Pnuemoperitoneum	Air or gas in the abdominal (peritoneal) cavity
pneumopericardium	Air in pericardium
Pneumomeiastinum	Air in mediastinum

You should know the name of the procedure and for which organ it is used:

Test	Organ Examined
Myelogram	Spinal cord
Sialogram	Salivary gland
Mamogram	Breast
Sinogram	Sinuses
Magnetic resonance cholangiopancreatography (MRCP)	Bile and pancreatic ducts
Endoscopic Retrograde Cholangiopancreatography (ERCP)	Bile and pancreatic ducts
Intravenous urography (IVU)	Kidneys

2) Ultrasound (US):

The machine sends out high-frequency sound waves, which reflect off body structures. A computer receives these reflected waves and uses them to create a picture. Unlike with an x-ray or CT scan, there is no ionizing radiation exposure with this test.

◆A very high frequency sound is directed into the body from a transducer placed in contact with the skin. In order to make a good acoustic contact; the skin is smeared with a jelly-like substance. As the sound travels through the body, it is reflected by the tissue interfaces to produce echoes, which are picked up by the same transducer and converted into an electrical signal.

US Advantages	US Disadvantages
Not-invasive	Operator dependent
No ionizing radiation	Organ limitation (it cannot penetrate air or bone e.g. can't be used to examine lungs or brain because of the skull)
Safe for pregnant patients	
Determine whether a structure is solid or cystic	

Echogenicity difference:
Hypo-echoic: Black (Less bright)
Hyper-echoic: White (Brighter)

◆Fluid is a good conductor of sound. Therefore, ultrasound is a particularly good imaging modality for:
1) Diagnosing cysts
2) Examining fluid-filled structures such as the bladder and biliary system
3) Demonstrating the fetus in its amniotic sac.

◆Ultrasound is often used to determine whether a structure is solid or cystic:
*Cysts or other fluid-filled structures produce **large echoes** from **their walls** but **no echoes** from the **fluid** contained within them.
*More echoes than usual are received from the tissues behind the cyst, an effect known as **acoustic enhancement**.
*With a calcified structure, e.g. a gallstone, there is a great reduction in the sound that will pass through, so a band of reduced echoes, referred to as an **acoustic shadow**, is seen behind the stone.

3) Computed tomography (CT Scan):

*Also know as X-ray computed tomography, computed axial tomography (CAT scan) or computer-assisted tomography.
*It is a medical imaging procedure that uses computer-processed X-rays to produce tomographic images or 'slices' (cross-sectional images) of specific areas of the body.

Remember, during the study:

*There is a large amount of radiation in CT examination.

*It can penetrate the skull. Thus, it is indicated in a stroke or hemorrhage (shows location and complications).

*Iv contrast is used with precaution (Because of the possible side effects, e.g. allergic reactions and extravasation: leakage of contrast into surrounding tissues)

*Oral contrast is safe.

◆ (CT) also relies on x-rays transmitted through the body. It differs from conventional radiography in that a more sensitive x-ray detection system is used, the images consist of sections (slices) through the body, and a computer manipulates the data.

◆CT has very small differences in x-ray absorption values compared with conventional radiography; the range of densities recorded is increased approximately 10-fold. So gradations of density within soft tissues can be recognized, e.g. brain substance from cerebrospinal fluid, or tumor from surrounding normal tissues.

◆ CT is not requested unless it is a must, and we can't use it for pregnant women unless it is crucial

CT angiography:

Rapid intravenous injections of contrast media result in significant opacification of blood vessels.

◆Which, with multi-planar or 3D reconstructions, can be exploited to produce angiograms. CT angiography, along with magnetic resonance angiography, is gradually replacing conventional angiography.

4) Magnetic Resonance Imaging (MRI):

Used in radiology to visualize internal structures of the body in details.

How does it work?

*An MRI scanner is a device in which the patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body

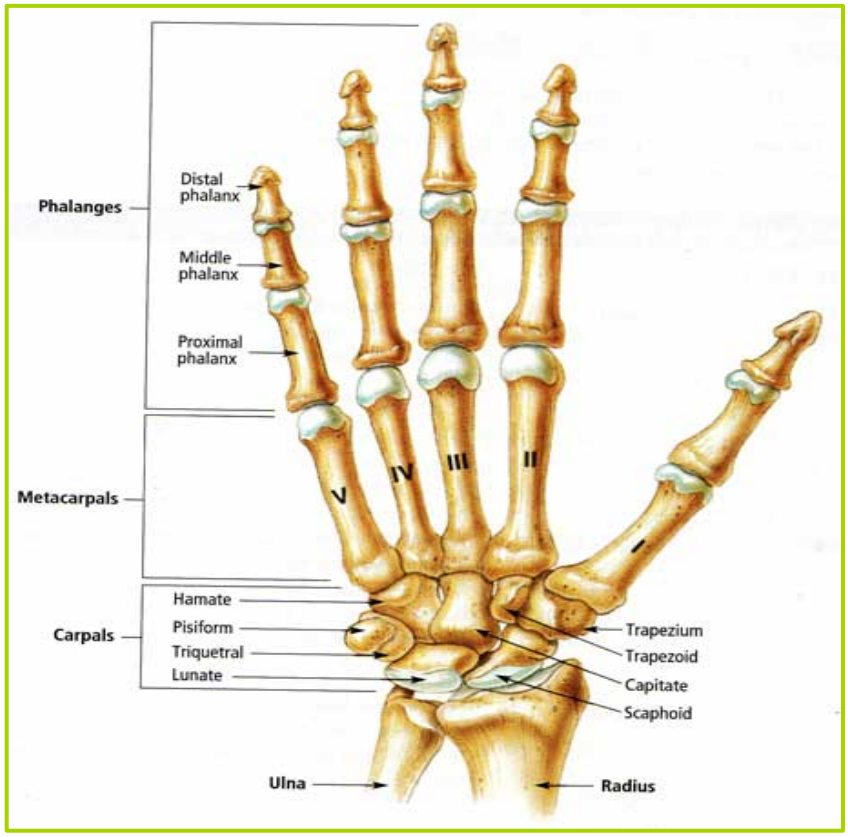
*Radiofrequency magnetic fields are applied to systematically alter the alignment of this magnetization. This causes the nuclei to produce a rotating magnetic field detectable by the scanner—and this information is recorded to construct an image.

◆In other words: Hydrogen atoms (protons) in water molecules and lipids >> magnetism affects all protons causes them to line up in one direction >> magnets can be switched on and off to change the direction of the magnetic field >> whenever the water molecule spin around they give a light radio wave >> MRI machine can detect it >> show it as images

MRI advantages	MRI disadvantages
Best for soft tissue imaging	Expensive
There is no ionization	Time consuming
Safe for pregnant women after the 1st trimester	Some people might be claustrophobic (fear of enclosed or narrow spaces)
Creates more detailed images of the body, compared to X-rays	Contraindication: Metals. E.G. pacemakers

2) The images:

You should know the normal anatomy of the hand. I.e. name of carpal bones



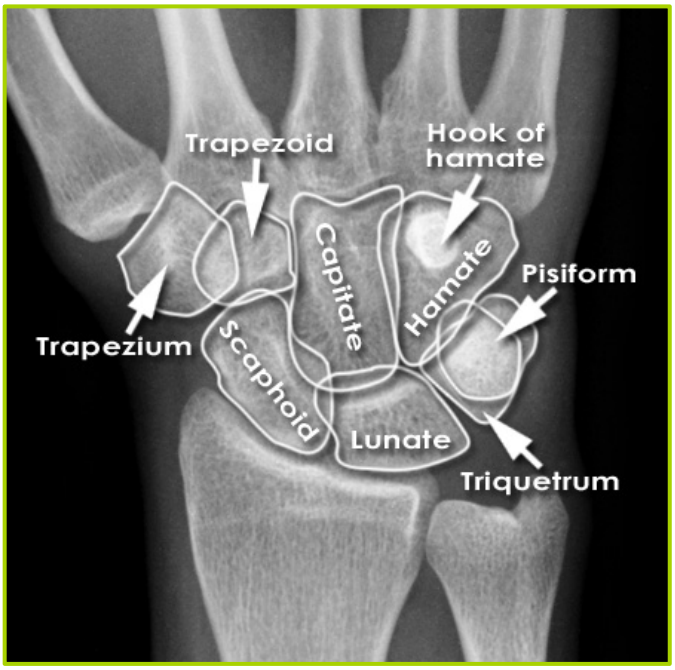
From Slides

Extra Images

Pneumonic to help you remember:

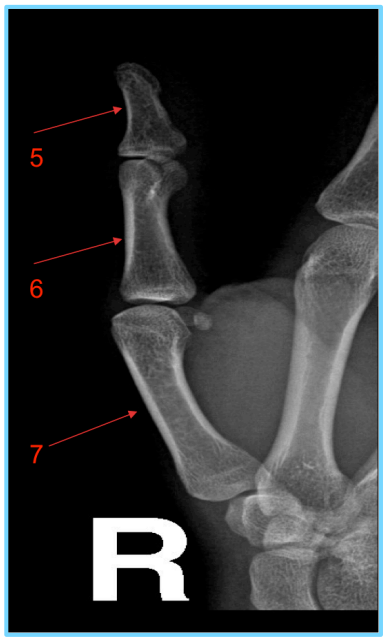
"She Looks Too Pretty; Try To Catch Her"
Proximal row then distal row, both lateral-to-medial:
Scaphoid
Lunate
Triquetrum
Pisiform
Trapezium
Trapezoid
Capate
Hamate

Left Hand

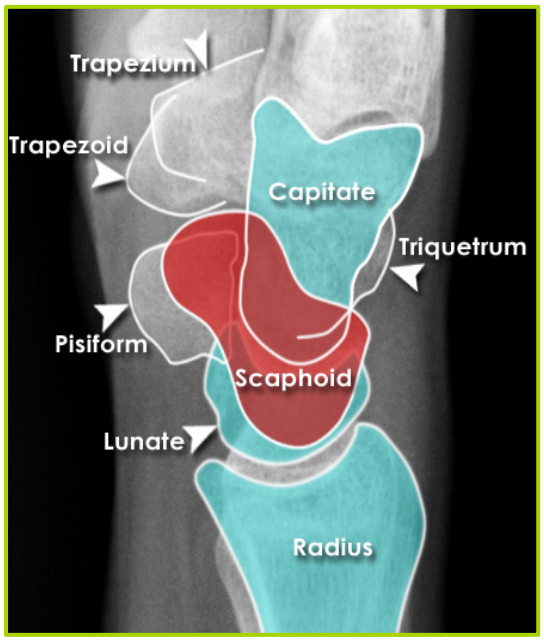


Right Hand

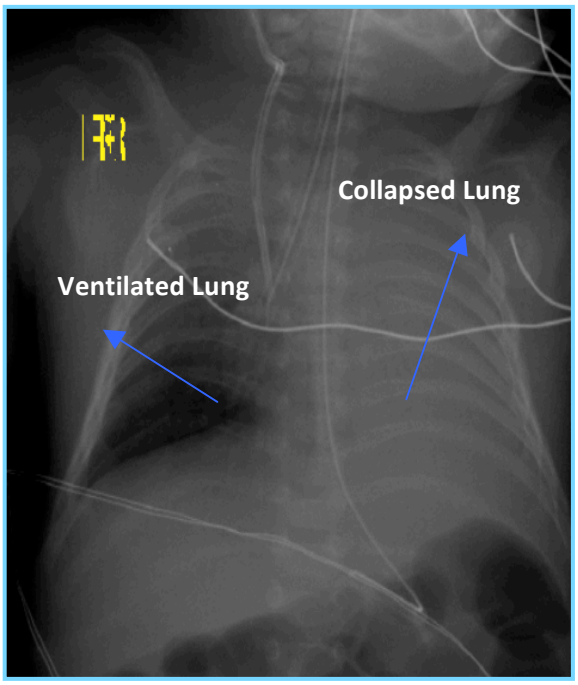
N.B *The pisiform and triquetrum overlap
*The other carpal bones partly overlap



1) Trapezoid 2) Scaphoid 3) Hammate 4) **T**riquetrum
5) Distal phalanx 6) Proximal phalanx 7) Metacarpal bone
*R means right hand



Later view: This view is essential to check for alignment of the radius, lunate and capitate



Chest X-ray (Pediatrics):

1) Where is the endo-bronchial tube allocated?

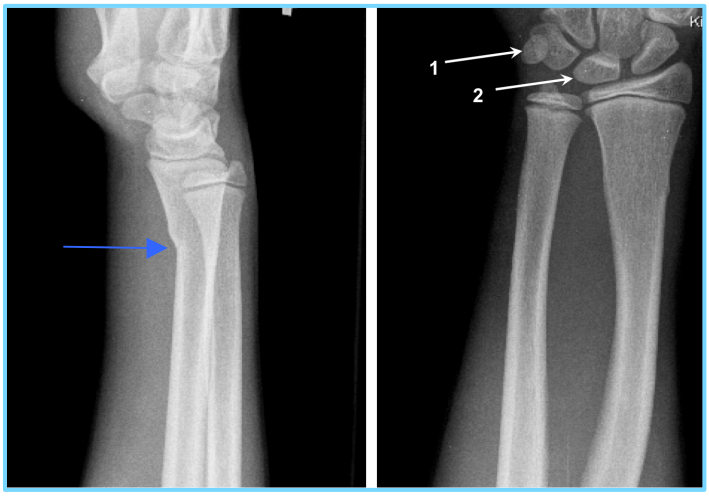
In the right lung.

2) How do you know that the right lung is normal?

It is translucent (black).

3) What happened to left hemi-thorax?

Collapsed lung.



1) Pisiform
2) Lunate

Is this image for an adult or pediatric?

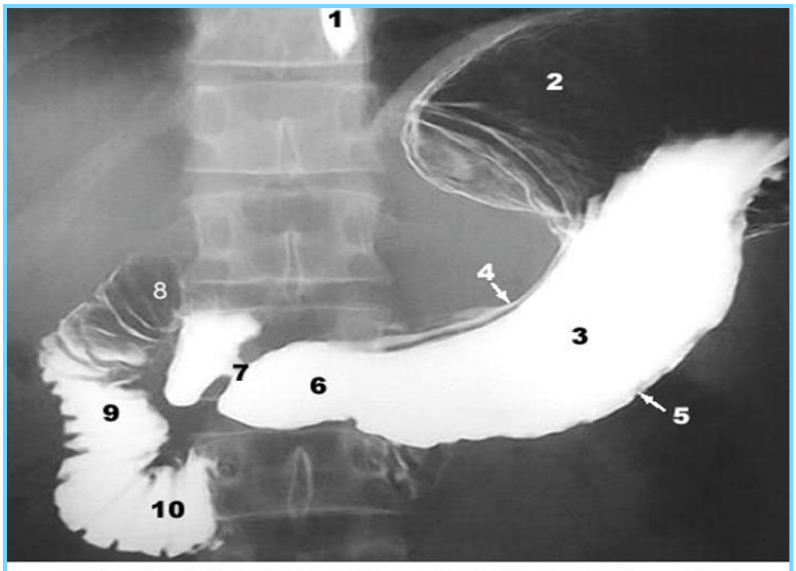
Pediatric because the bones are not fused (we can see the growth plate)

What type of fracture and where?

Torus (Buckle) fracture in the distal radius.

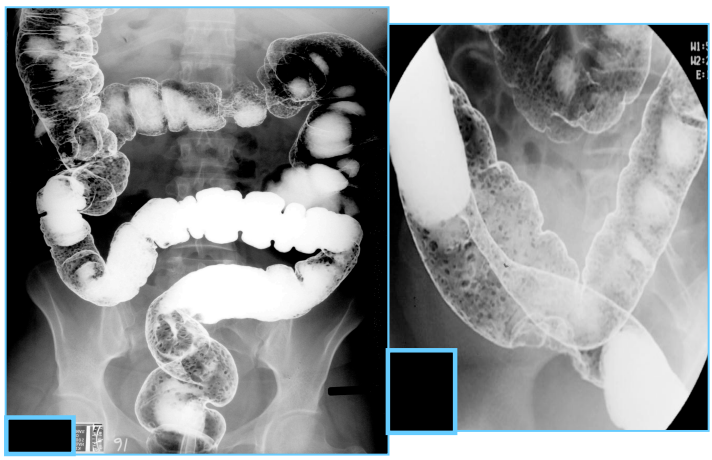
Pneumopertonuim

Normal anatomy of the upper GI (Barium Meal)

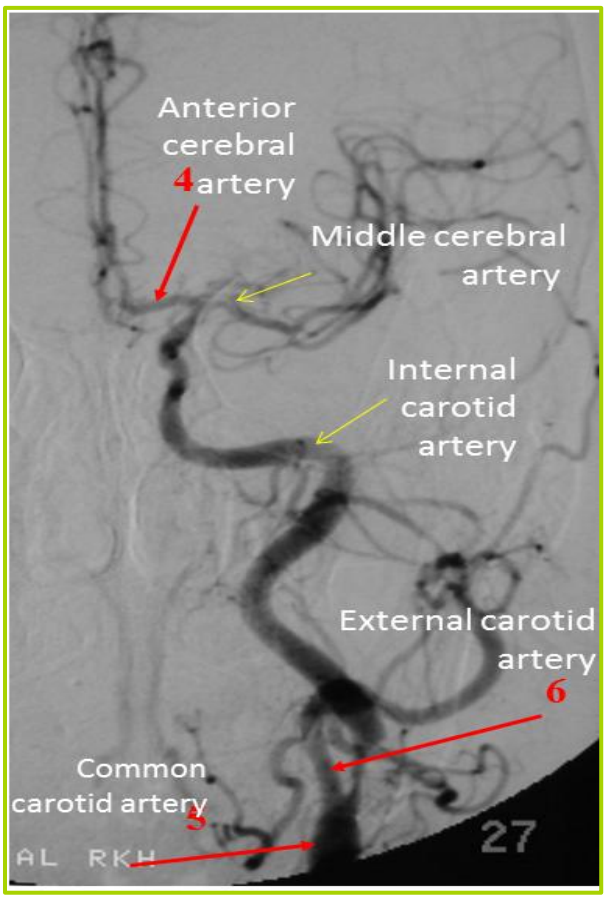


1 esophagus 2 fundus of the stomach 3 body of the stomach
4 lesser curvature 5 greater curvature 6 pyloric antrum
7 pylorus 8 duodenal bulb (1st half of 1st stage of duodenum)
9 2nd stage of duodenum 10 3rd stage of duodenum

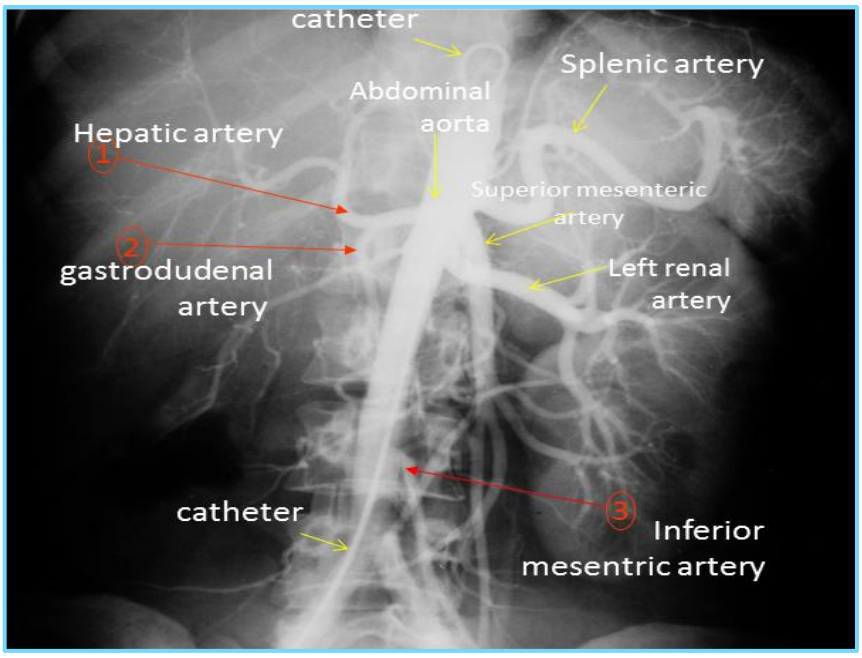
Barium enema. Double contrast (contrast & gas)

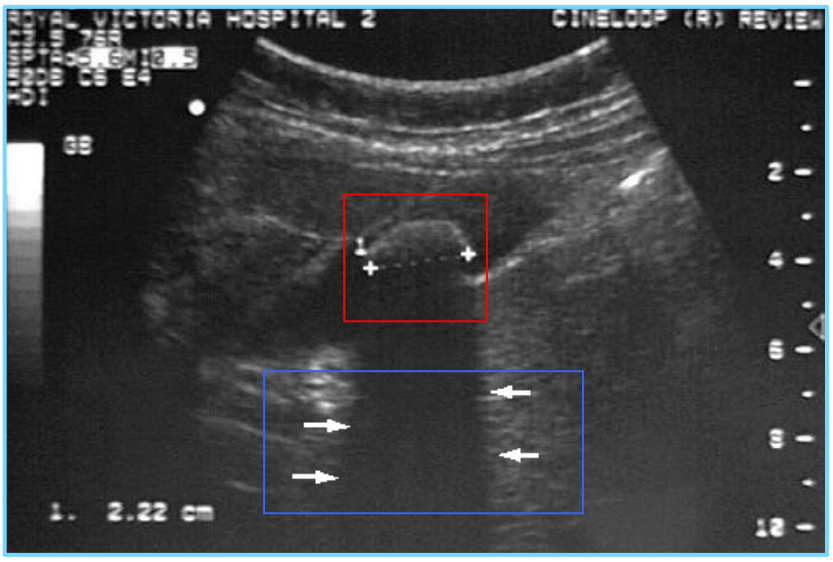


Cerebral Angiogram



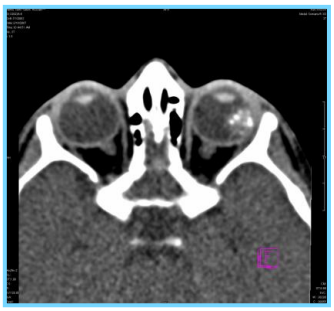
Abdominal Angiogram





- Gall stone size is shown between the two crosses (2.22 cm).

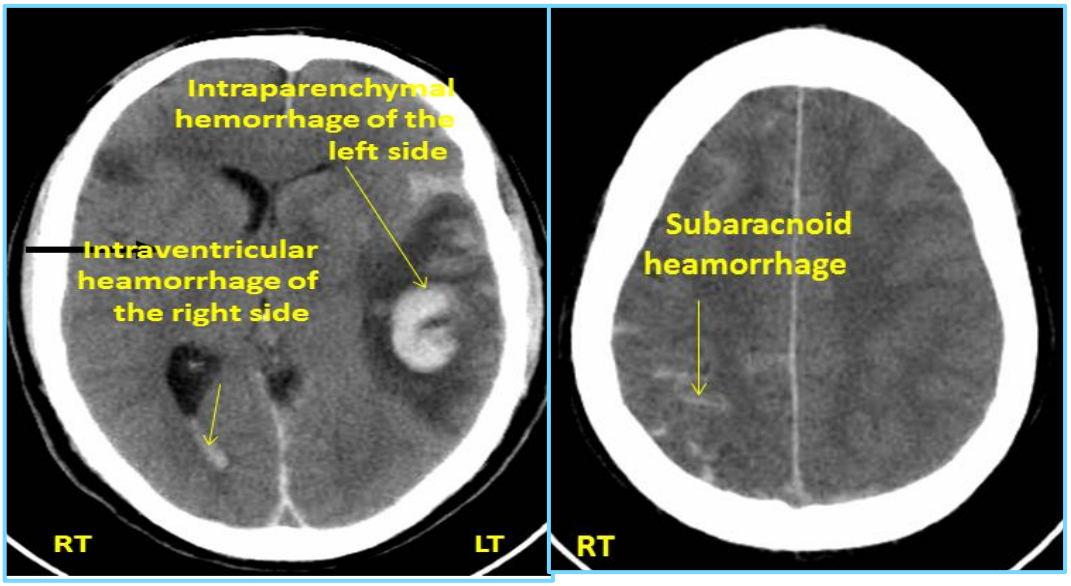
- Arrows identify the acoustic shadow behind the stone



Leukocoria

CT scan, an axial cut of the orbit, abnormality is in the temporal aspect of the left globe partially calcified

(The disease in the globe is: retinoblastoma)

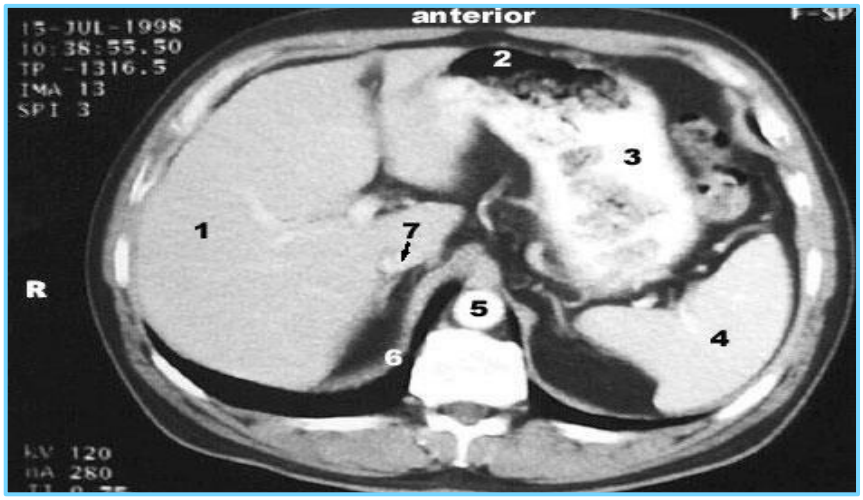


CT scans of the brain.

Remember:

*Patient with right hemiplegia: Left side lesion

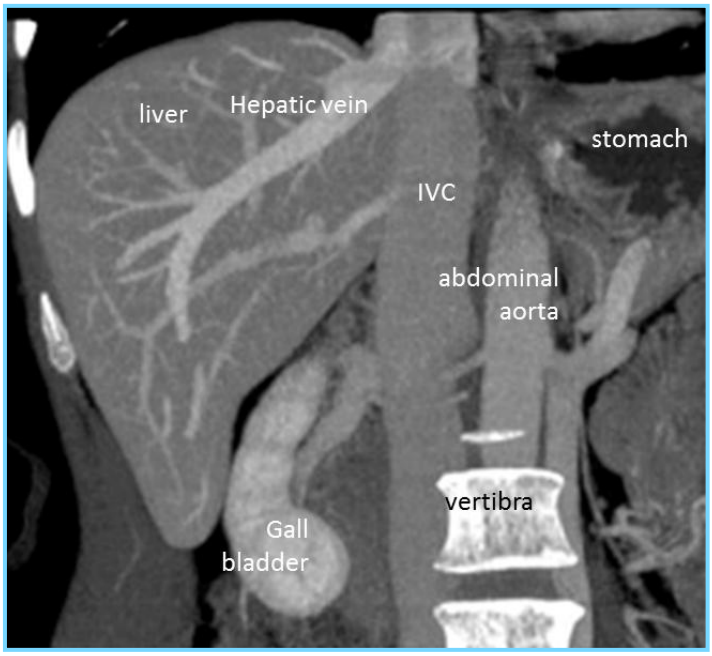
*Patient with left hemiplegia: Right side lesion



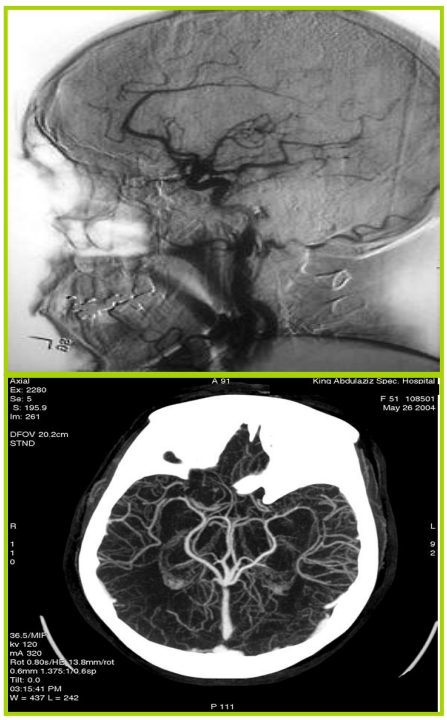
CT scan of the abdomen:

1) Liver
2) Gas in the stomach
3) Stomach
4) Spleen
5) Aorta
6) Crus of the diaphragm
7) Inferior vena cave

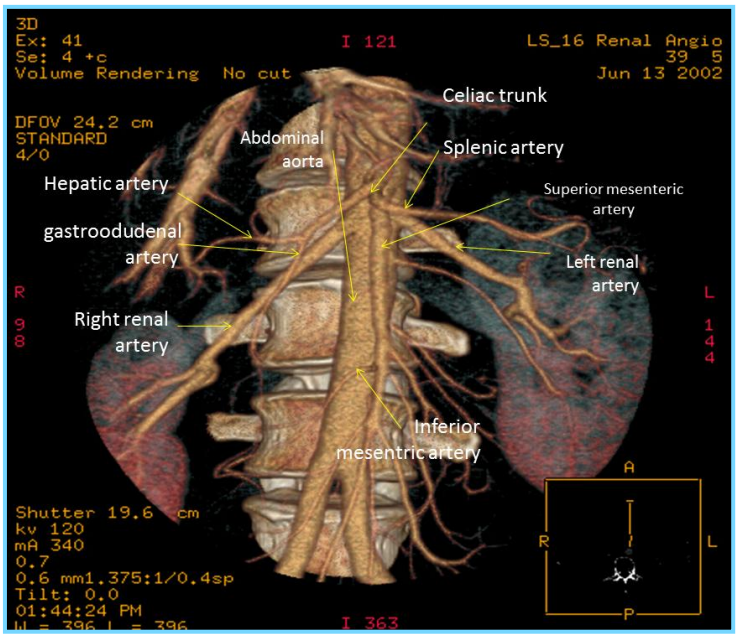
CT Coronary Angiogram



Coronal Image Abdomen (CT with contrast)



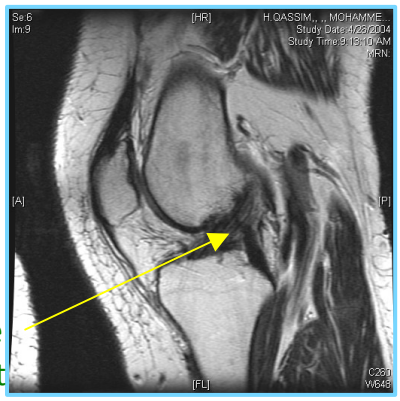
Cerebral Angiogram



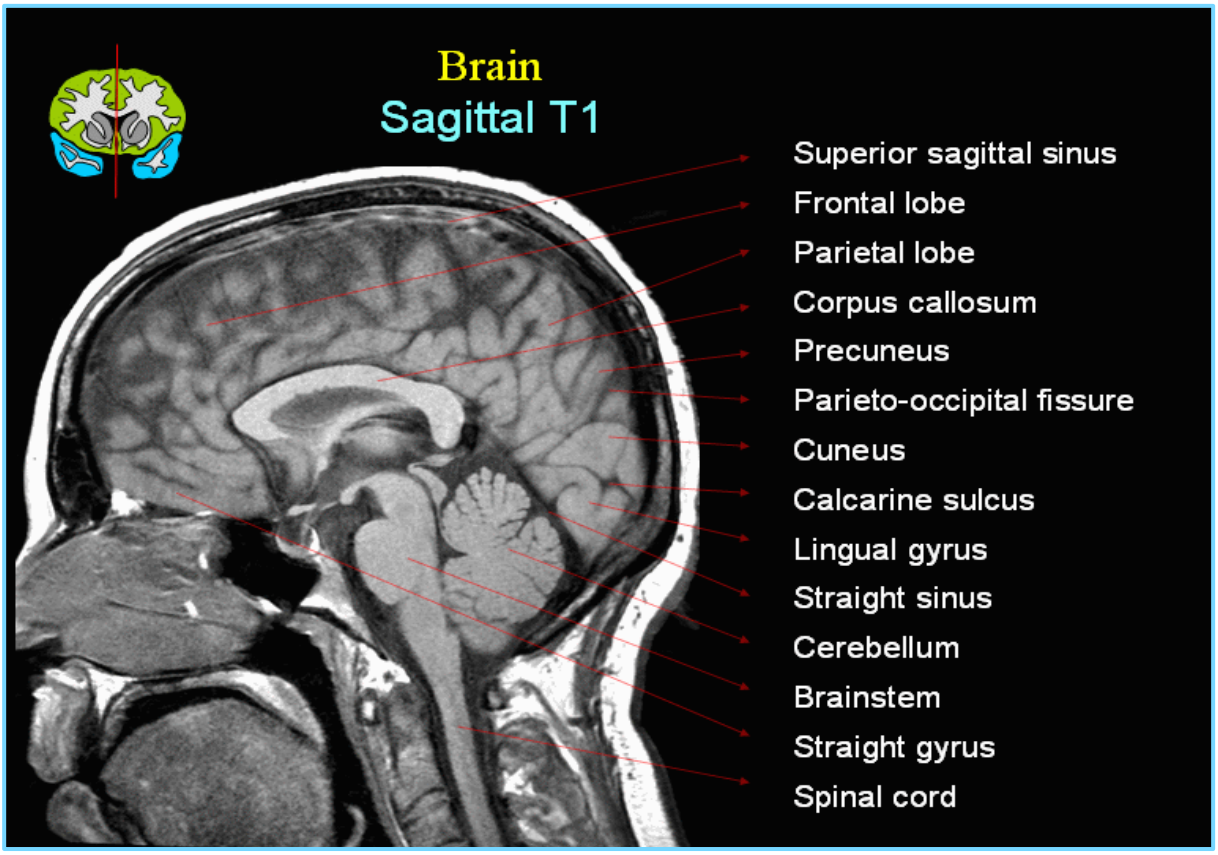
3D Abdominal Angiogram

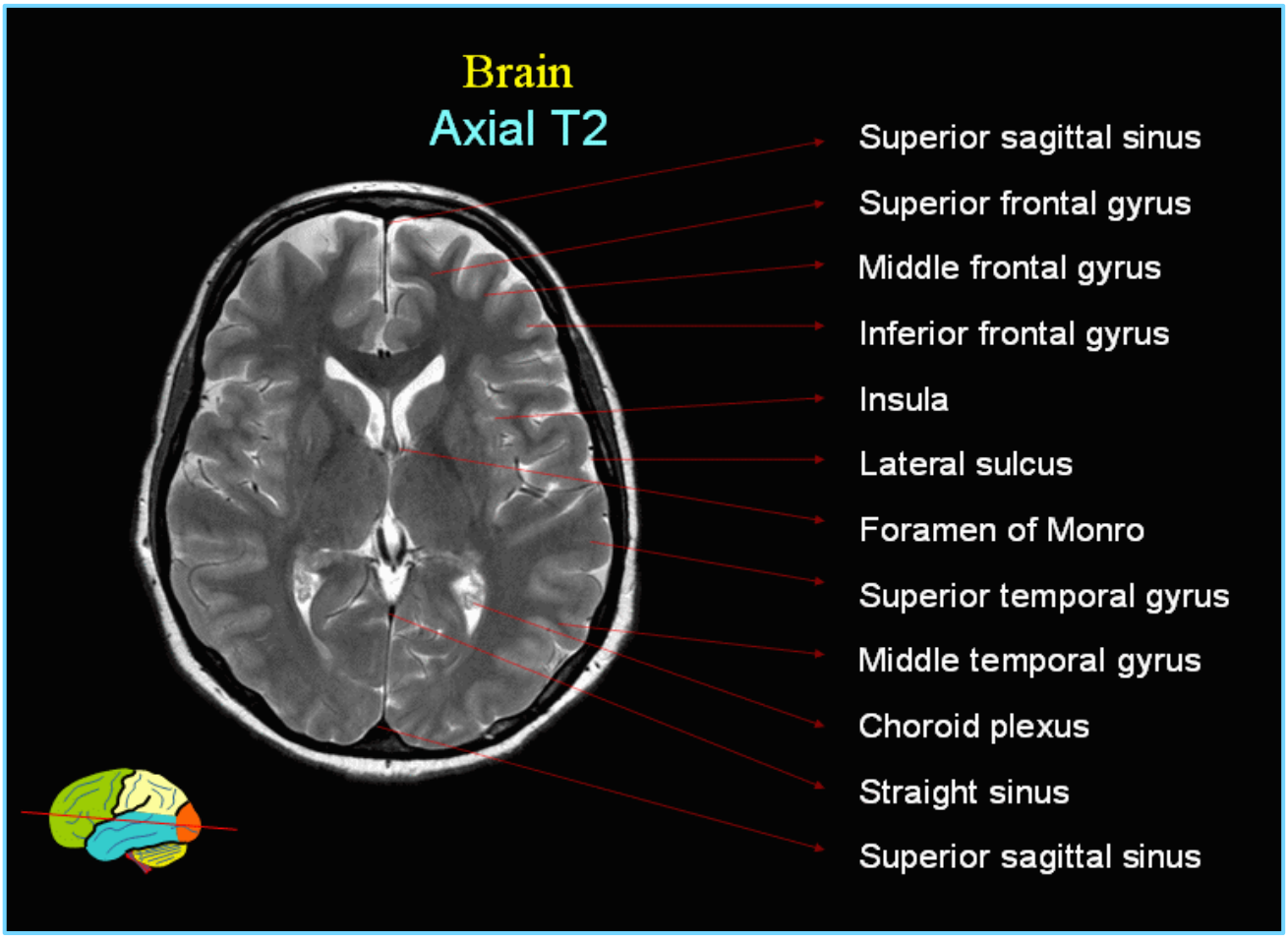
X-Ray: Only bone is seen
Ligament is NOT seen

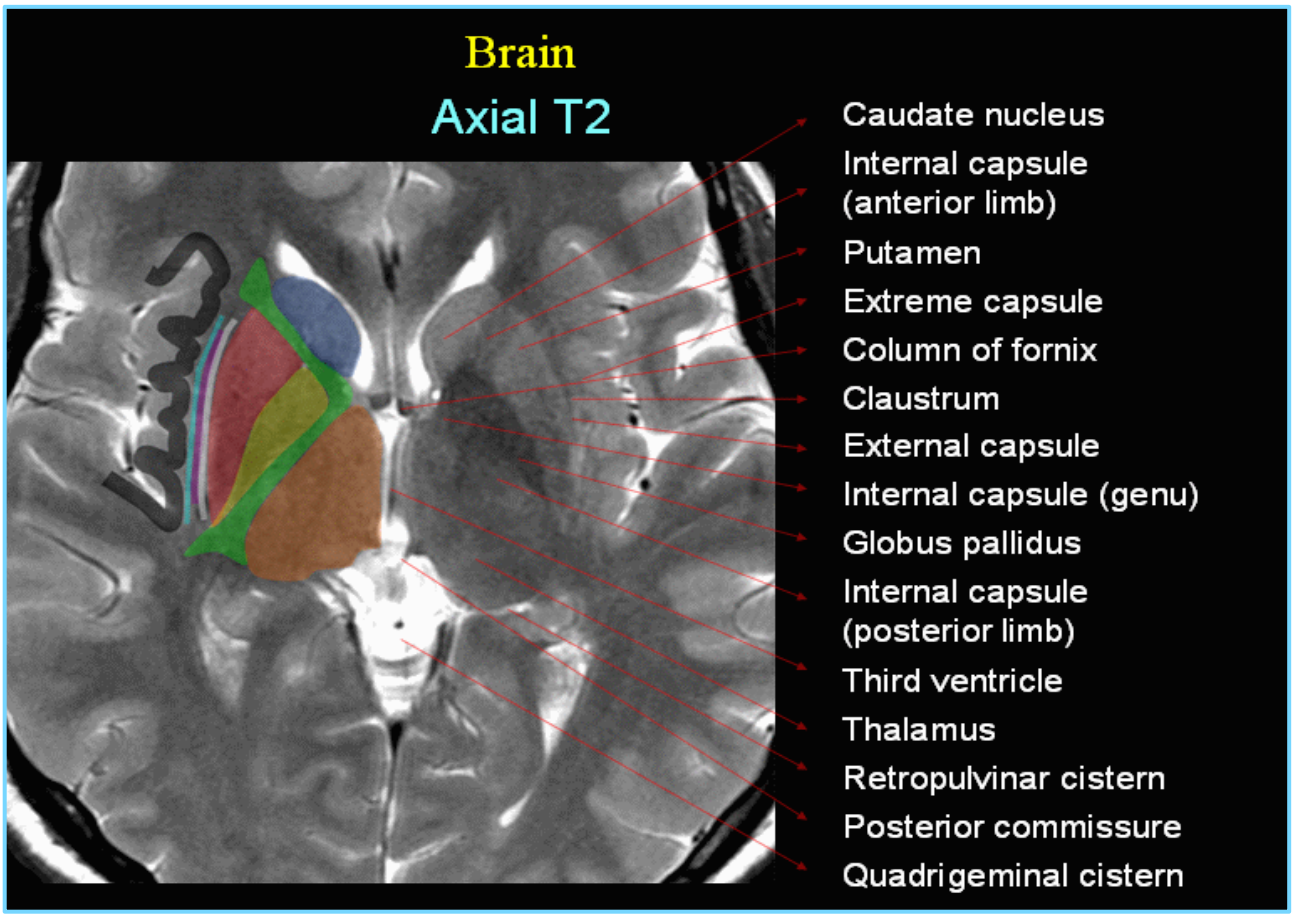
Images of the Knee
X-Ray V.S. MRI

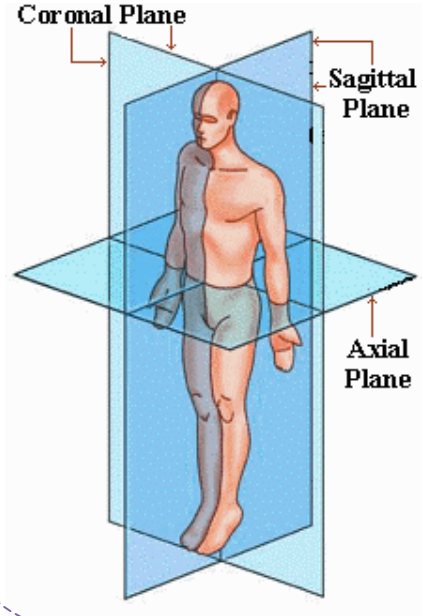


MRI: Soft tissue better visualized


Brain
Sagittal T1
Superior sagittal sinus
Frontal lobe
Parietal lobe
Corpus callosum
Precuneus
Parieto-occipital fissure
Cuneus
Calcarine sulcus
Lingual gyrus
Straight sinus
Cerebellum
Brainstem
Straight gyrus
Spinal cord


Brain
Axial T2
Superior sagittal sinus
Superior frontal gyrus
Middle frontal gyrus
Inferior frontal gyrus
Insula
Lateral sulcus
Foramen of Monro
Superior temporal gyrus
Middle temporal gyrus
Choroid plexus
Straight sinus
Superior sagittal sinus





You should know the planes:
1) Sagittal
2) Axial (transverse)
3) Coronal

Extra Info: When giving contrast medium, patients must be Adequately hydrated to prevent contrast medium induced nephropathy & acute renal failure. Especially patients who have risk factors for developing it.
To know more:
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1562477/

A helpful website from Mohammed AlShammari (Thank you Mohammed)
http://radiologymasterclass.co.uk/gallery/galleries.html