

432 Team Radiology



(1): introduction to Radiology

* Many thanks to 431 team for their helpful notes *



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COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional • 431 team

Objectives

1. To learned different type of radiology modalities.
2. To have the principle of the indication and contra- indication for different radiology investigation.
3. Usage of different type of contrast.

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 tissue and calcified structures.

Structure	Appearance
Air	X-rays that pass through air are the least absorbed (the most blackening of the radiograph)
Bone & other calcified tissues	Calcium absorbs the most and virtually white .
Soft tissues (except fat)	Various shades of grey * depending on how dens they are *
Fat	Absorbs slightly fewer x-rays and appears a little blacker than other soft tissues.

- **In x-ray : black coloration (Radio-lucent) is called (lucency) , white coloration (Radio-opaque) is called (opacity)**

Note:

From the most black to the most white:

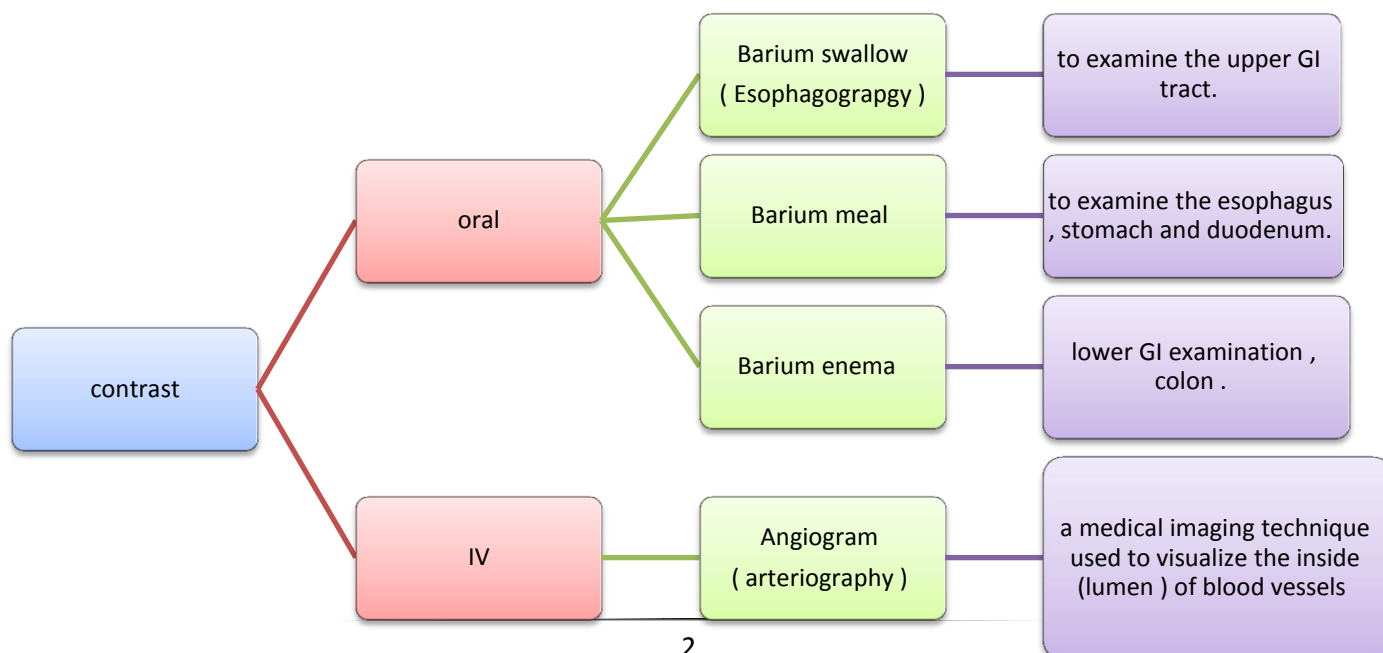
- 1- Air
- 2- Fat
- 3- Soft tissue
- 4- Bone

- 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):



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.
Pneumoperitoneum	Air or gas in the abdominal (peritoneal) cavity.
pneumopericardium	Air in pericardium
Pneumomediastinum	Air in mediastinum.

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

Test	Organ
Myelogram	Spinal cord
Sialogram	Salivary gland , carotid and submandibular ducts
Mamogram	Breast
Sinogram	sinuses
Magnetic resonance cholangio-pancreato-graphy. (MRCP)	Bile and pancreatic ducts
Endoscopic retrograde cholangio-pancreato-graphy. (ERCP)	Bile and pancreatic ducts
Intravenous urography	kidneys
ductogram	Breast ducts

2- CT (computerized axial tomography):

- Also known 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.
- (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 the data are manipulated by a computer.
- 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.
- There is major risk behind CT scan, **1 brain CT scan radiation = 200 x-ray radiation, pelvic CT radiation = 400 x-ray radiation** which means don't request a CT scan unless it is needed and we **can't use it for a pregnant women** unless it is necessary .

Note:

Remember:

- 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).** " Hemorrhage always hyper dense "
- **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.**

In CT we use the word (Dense):

- 1- Hyper –dense.
- 2- Iso-dense (iso =in between).
- 3- Hypo-dense.

CT angiography:

Rapid intravenous injections of contrast media result in **significant opacification of blood vessels**, which, with multiplanar or 3D reconstructions, can be exploited to produce angiograms. CT angiography, along with magnetic resonance angiography, is gradually replacing conventional angiography.

3- Ultrasound:

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.**

- Is a very high frequency sound is directed into the body from a transducer placed in contact with the skin. In order to make 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.

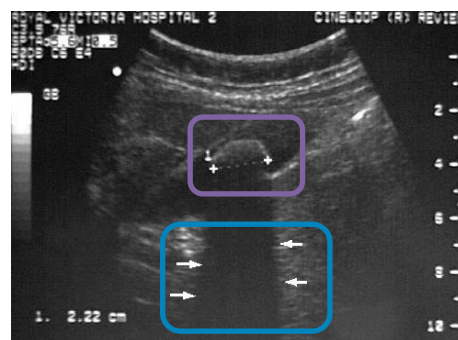
- **Echogenicity difference:**



US advantages	US disadvantages
Not-invasive	Operator dependent
No ionizing radiation	
Safe for pregnant patients	organ limitation (it cannot penetrate air or bone so we can't use it with lung or brain for instance)
Determine whether a lesion is cystic or solid	

- 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 **gall stone**, 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.



Gallstone size is shown between the two crosses (2.22 cm), arrows identify the acoustic shadow behind the stone.

- Fluid is a good conductor of sound, and ultrasound is, therefore, 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.

4- Magnetic Resonance Imaging (MRI):

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

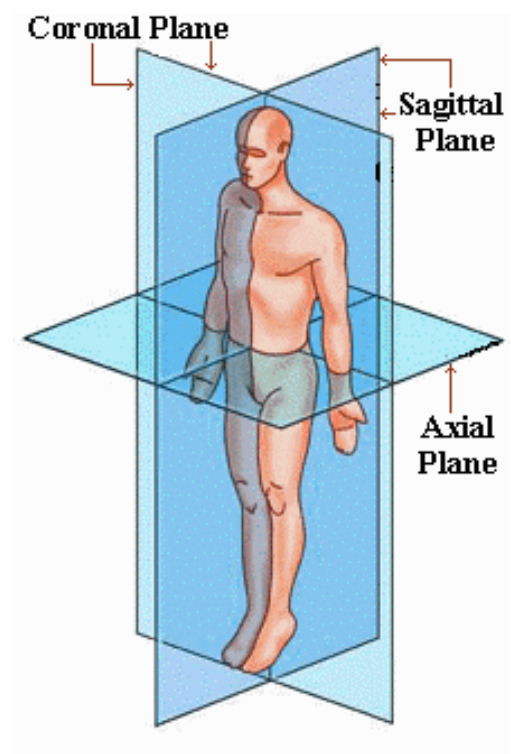
(We use the word "intense" in image description)

How does it work?

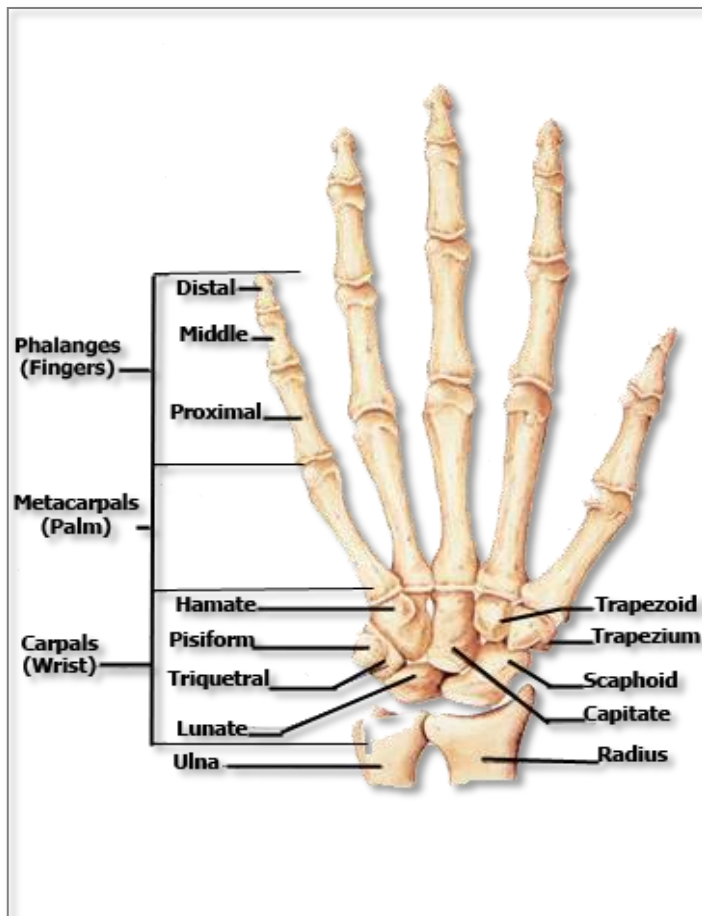
Simply, hydrogen atoms (protons) in water molecules and lipids >> magnetism affects all protons causes them to line up in one direction >> magnets can be switched on and off to change the direction of the magnetic field >> whenever the water molecule spin around they give a light radio wave >> MRI machine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

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

- **MRI is contraindicated if there is**
 - **Metallic Cardiac Piece makers**
 - Intracranial vascular clip
 - Neurostimulators of any sort
 - Intraocular metallic foreign bodies
 - Ossicular implantation
 - Any metallic implants: metal plates, pins, rods,etc
 - Hair pieces
 - Any prosthetic devices
 - Heart failure
 - Surgical clips on the arteries and wire sutures
 - Heart valve , **Pregnancy** , Shrapnel , Metallic/silver eye liners
- **You Have to know**
 - What is Sagittal, axial (transverse), coronal planes?



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
- Capitate
- Hamate



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

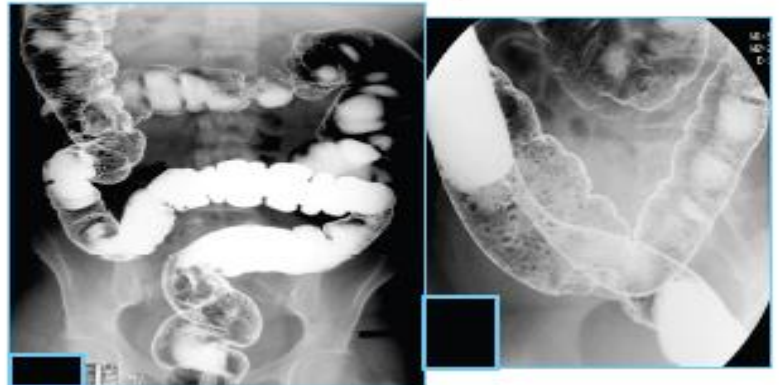


Later view: This view is essential to check for alignment of the radius, lunate and capitate

Pneumoperitonium



Barium enema. Double contrast (contrast & gas)

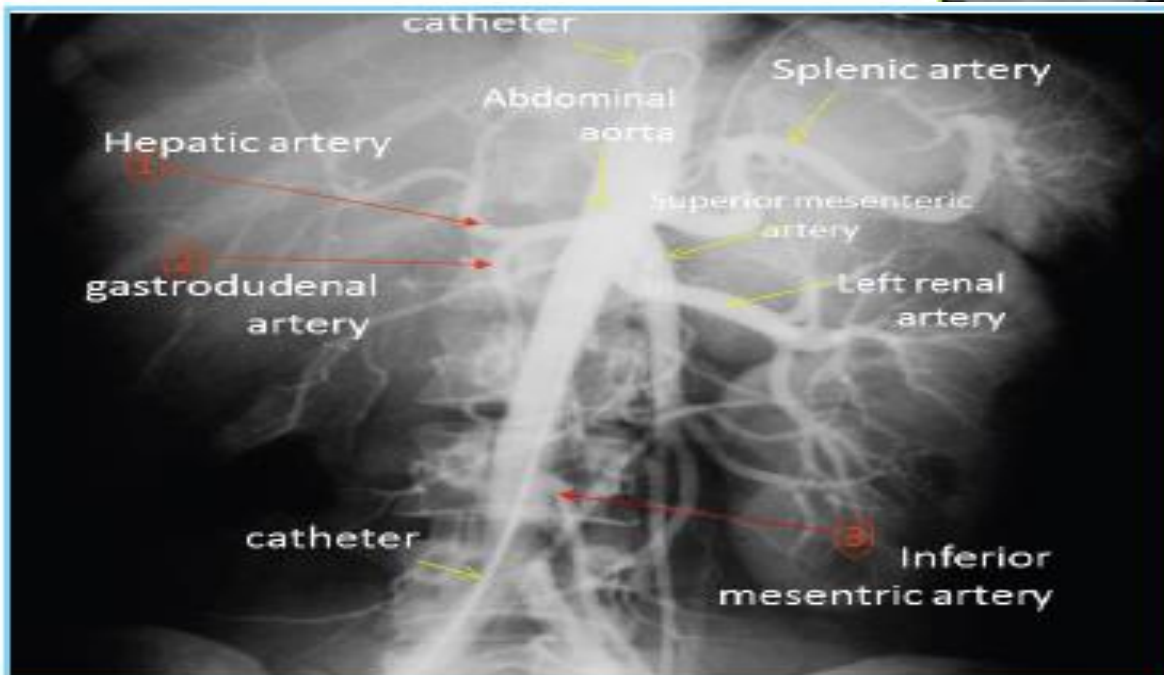
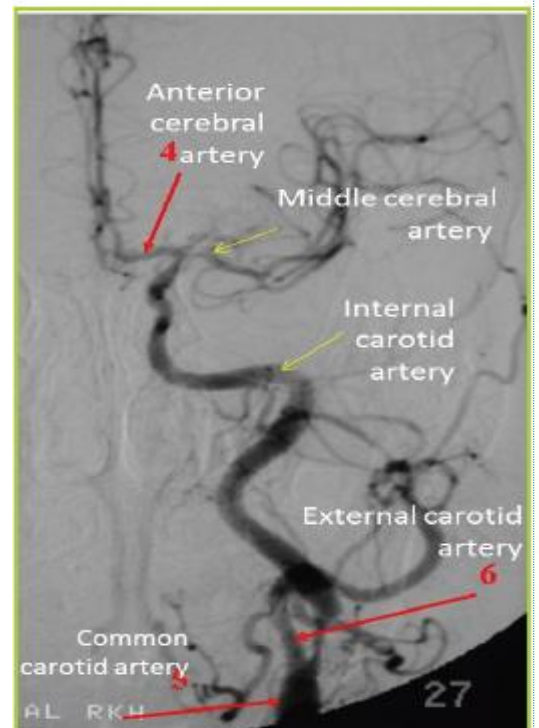


Cerebral Angiogram

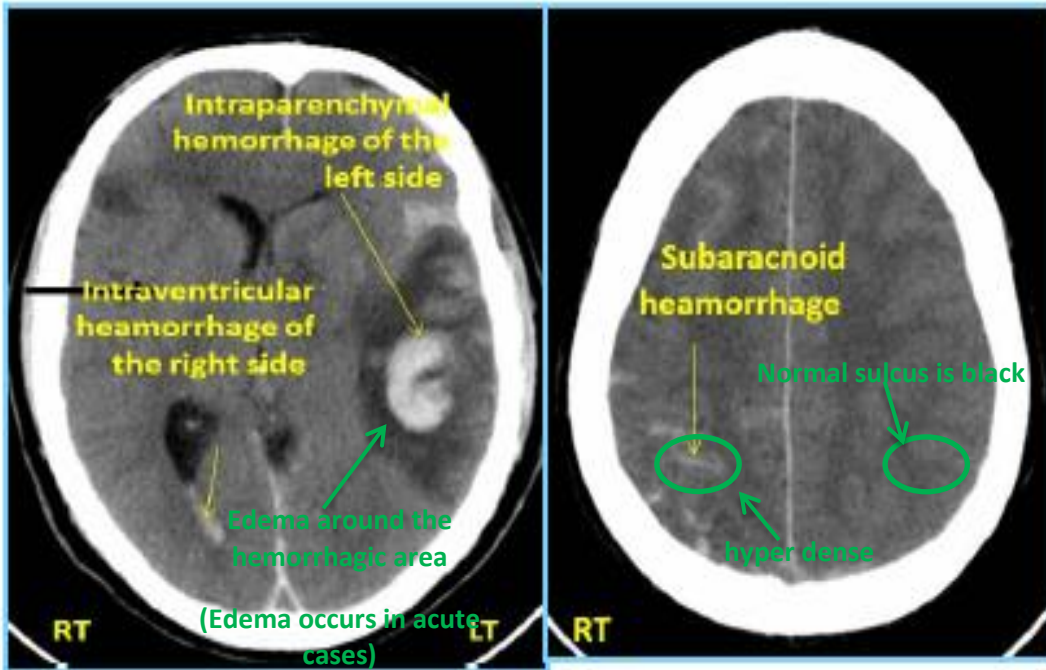
Normal anatomy of the upper GI (Barium Meal)



- 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



Abdominal angiogram



CT scan of the brain.

Remember:

- Patient with right side hemiplegia: left side lesion.
- Patient with left side hemiplegia: right side lesion.



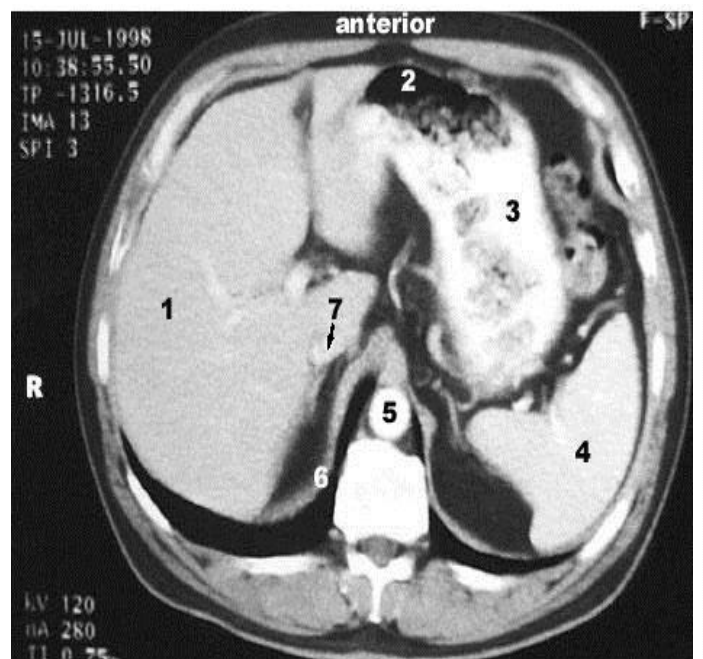
Leukocoria:

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

The disease in the globe is: **retinoblastoma**

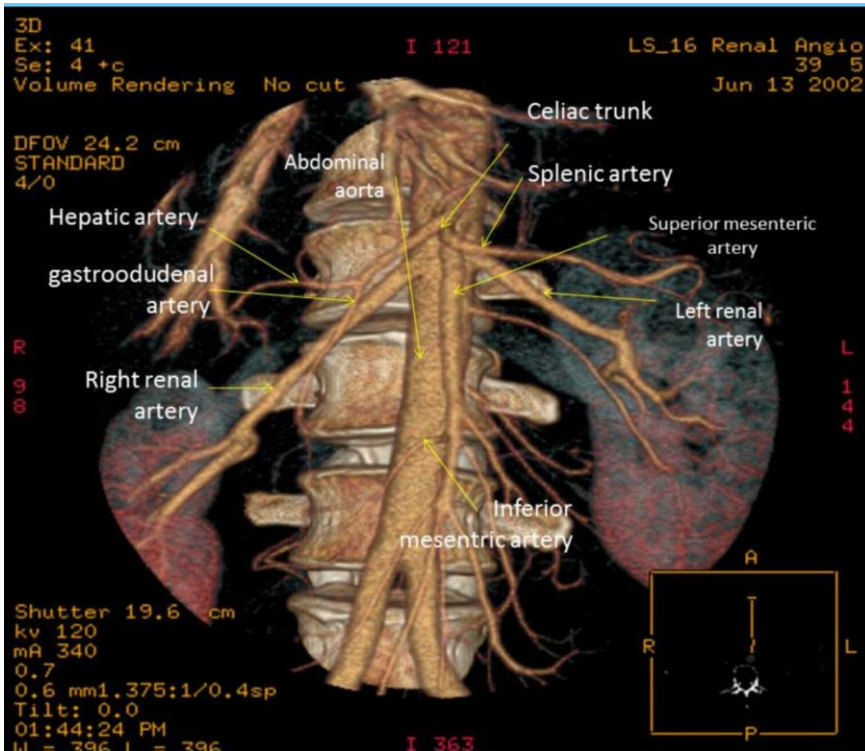


US of the Liver.

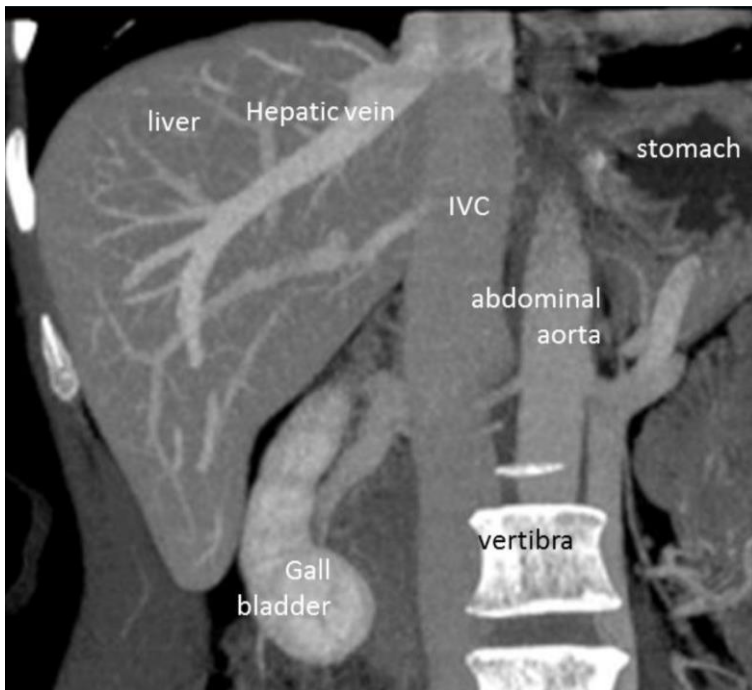
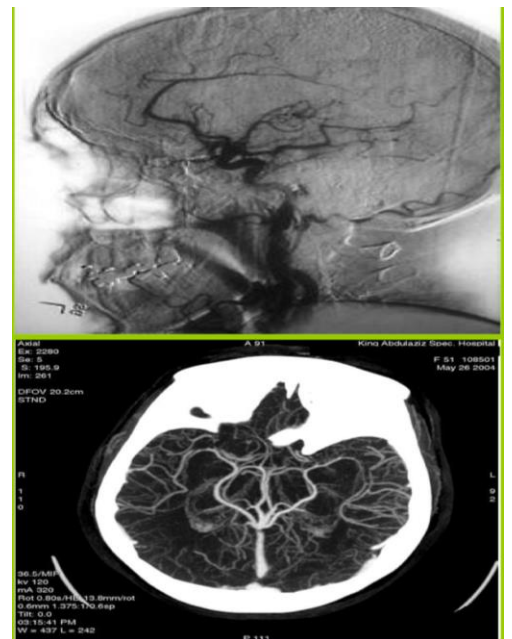


1 liver 2 gas in the stomach 3 stomach 4 spleen 5 aorta 6 crus of the diaphragm 7 inferior vena cava

3D abdominal angiogram



Cerebral angiogram

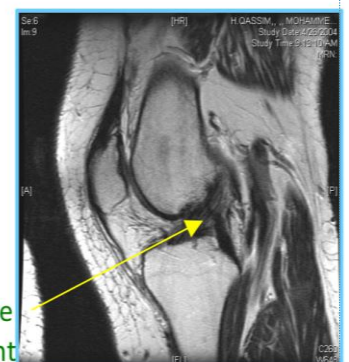


Coronal image of the abdomen (CT with contrast)



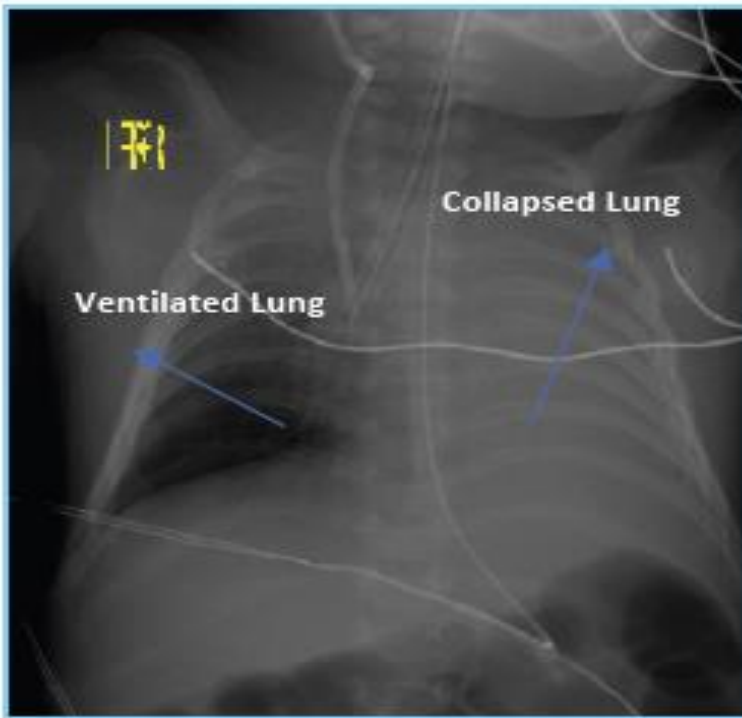
X-Ray: Only bone is seen
Ligament is NOT seen

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



Cruciate ligament

MRI: Soft tissue better visualized



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

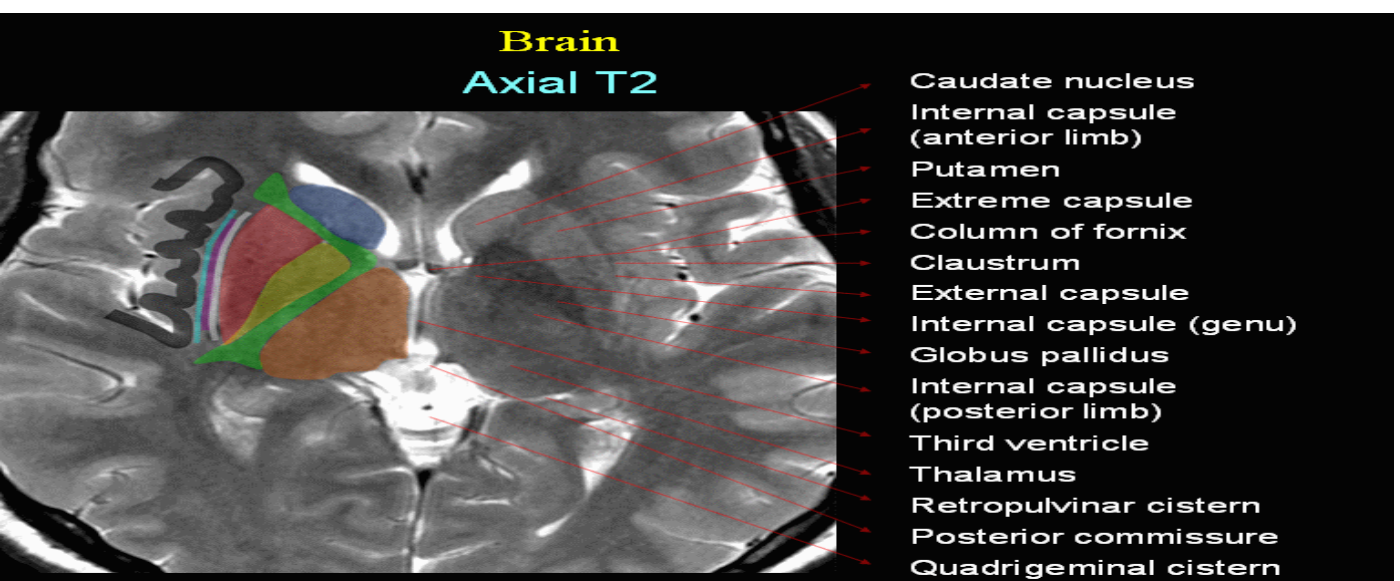
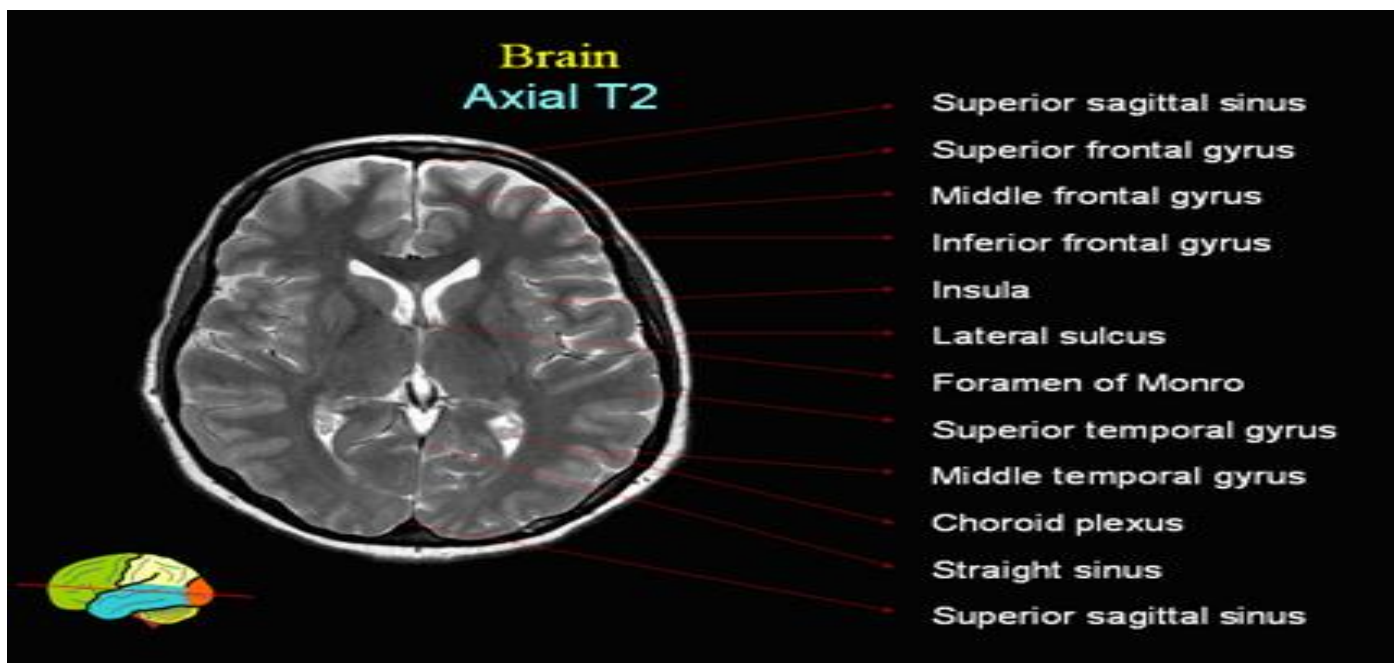
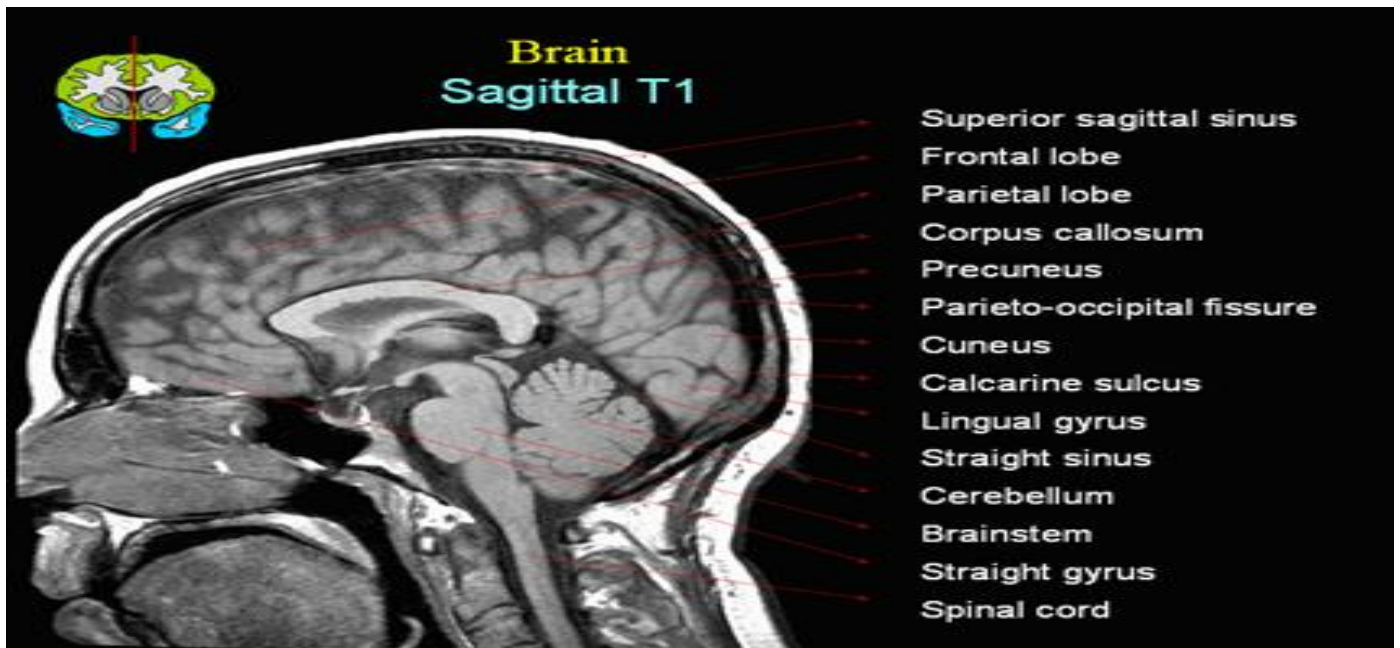
2) Lunate

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.



Note(s):

- MRI contrast may cause nephrogenic systemic fibrosis when we give it to chronic renal failure patient
- Metallic Pacemaker is contraindicated in MRI, Titanium is fine
- Claustrophobia is a relative contraindication in MRI
- MRI contrast: You have to take precaution if there is renal impairment
- CT contrast: You have to take precaution if there is renal impairment or allergy

The doctor mentioned something about the difference b/w MRCP and ERCP, you should take a look through them

SUMMARY

1. There are four basic densities detected in radiograph – gas (the most blackening), fat, all other soft tissue and calcified structures (the most bright/white).
2. The image on an x-ray film is two-dimensional. All the structures along the path of the beam are projected on to the same portion of the film. Therefore, **it is often necessary to take at least two views to gain information about the third dimension.**
3. CT can penetrate the skull. Thus, it is **indicated in a stroke or hemorrhage** (shows location and complications).
4. **CT scan can't be used for a pregnant woman unless it is necessary.**
5. US no ionizing radiation.
6. **US Determine whether a lesion is cystic or solid.**
7. MRI is contraindicated if there is Cardiac Piece maker or if there is any metal.
8. US>> Echoic, CT>> Dense, MRI>> intense.

Questions

- 1) Which one of the following is the most blackening density in radiograph is?
 - a. fat
 - b. soft tissue
 - c. air
 - d. bone

- 2) Myelogram is the examination of?
 - a. Spinal cord
 - b. kidney
 - c. breast
 - d. bile duct

- 3) which one of the following can determine whether the lesion is cystic or solid ?
 - a. X-ray
 - b. US
 - c. MRI
 - d. CT

- 4) MRI can be safe for pregnant women after?
 - a. 1st trimester
 - b. 2nd trimester
 - c. 3rd trimester
 - d. Never use during pregnancy

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Answers:

- 1st Questions: C
2nd Questions: A
3rd Questions: B
4th Questions: A