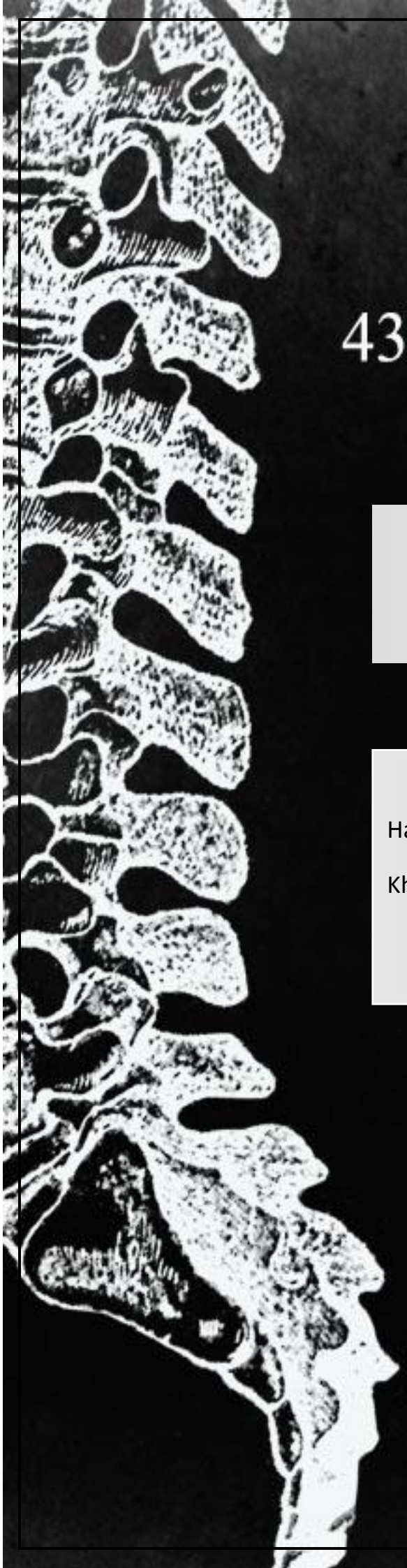


430 Radiology team

Lecture - 1

Introduction to Radiology

Maha AlKubidan

Hanan AlSalman

Hanan Alrabiah

Khawla AlOthman

Ghadeer AlWuhayd

- It is important to know the normal anatomy to understand radiology

❖ The different types of radiological investigation

- Our Aim is; this image has to simulate the actual object so that we can diagnose depending on normal anatomy and expected pathology (we should differentiate between bone and soft tissue , in the brain we should differentiate between gray and white matter)

❖ 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

- X-rays that pass through **air** are least absorbed and, therefore, cause **the most blackening** of the radiograph,
- Whereas calcium absorbs the most and so the **bones** and other calcified structures appear virtually **white**.
- The **soft tissues**, with the exception of fat all have similar absorptive capacity and appear the same shade of **grey**
- **Fat** absorbs slightly fewer x-rays and, therefore, appears **a little blacker than the other soft tissues.**
- Black coloration is called opacity & white coloration is called lucency

- Projections are usually described by the path of the x-ray beam. Thus, the term PA (poster anterior) view designates that the beam passes from the back to the front, the standard projection for a routine chest film.

- 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

❖ CT scan (computerized axial tomography)

- (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, 1barin 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

❖ 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.

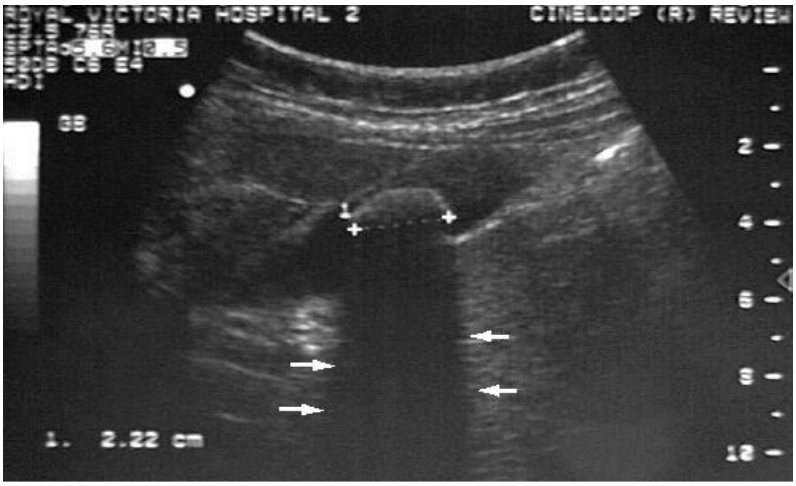
❖ Ultrasound

- 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.

- Not-invasive
- Operator dependant
- There is no radiation
- Safe for pregnant patients
- There is organ limitation (it cannot penetrate air or bone so we can't use it with lung or brain for instance)

- Fluid is a good conductor of sound, and ultrasound is, therefore, a particularly good imaging modality for diagnosing cysts, examining fluid-filled structures such as the bladder and biliary system, and 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. Also, more echoes than usual are received from the tissues behind the cyst, an effect known as **acoustic enhancement**. Conversely, 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.

❖ **MRI (**magnetic **resonance imaging)**

- 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

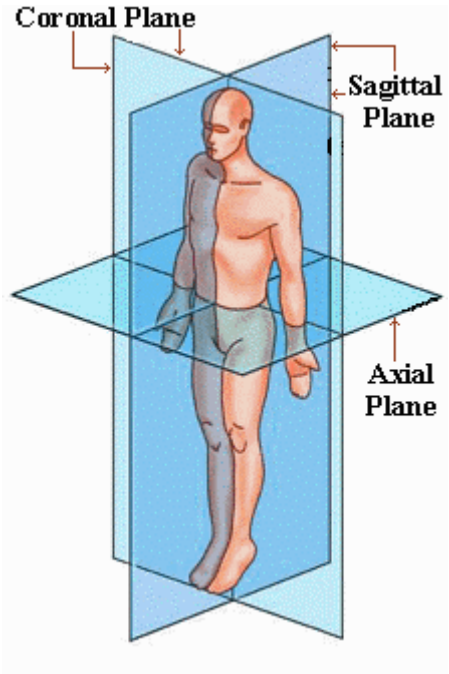
MRI advantages	MRI disadvantages
Best for soft tissue imaging	expensive
There is no ionization	Time consuming
it can be done for pregnant women with caution	patients fear it and dislike it because it is a narrow place
	Since it is magnetic no metals can be allowed
	Patient has to keep still during scanning procedure
	Images can be directly in any plane

❖ **MRI is contraindicated if there is**

- 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

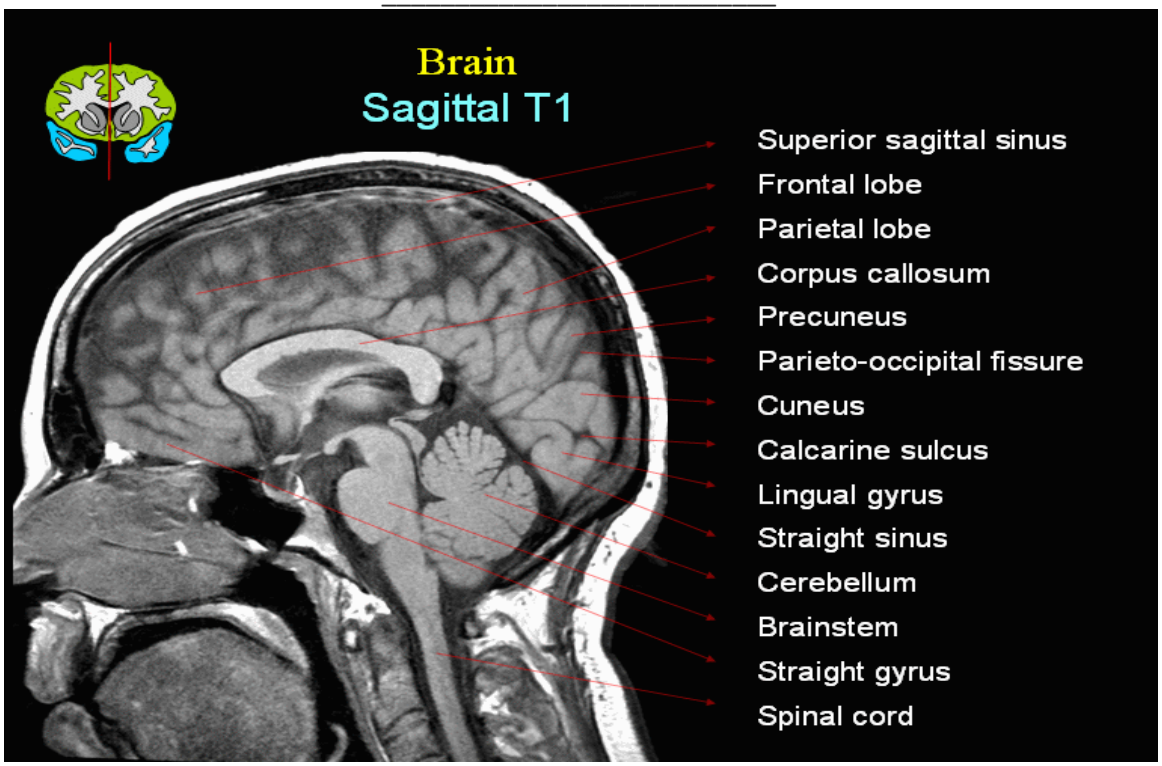
❖ **You Have to know**

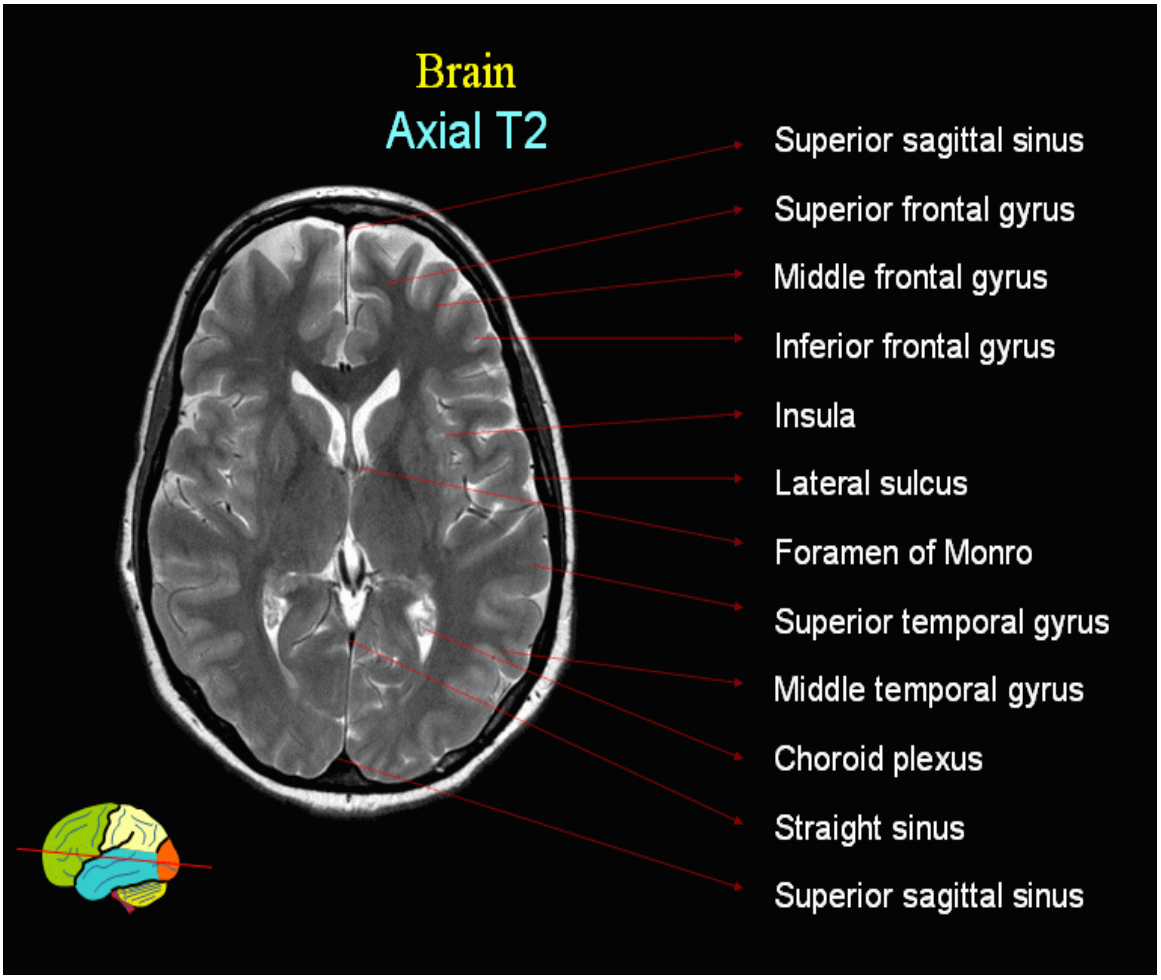
- What is Sagittal, axial (transverse), coronal planes?

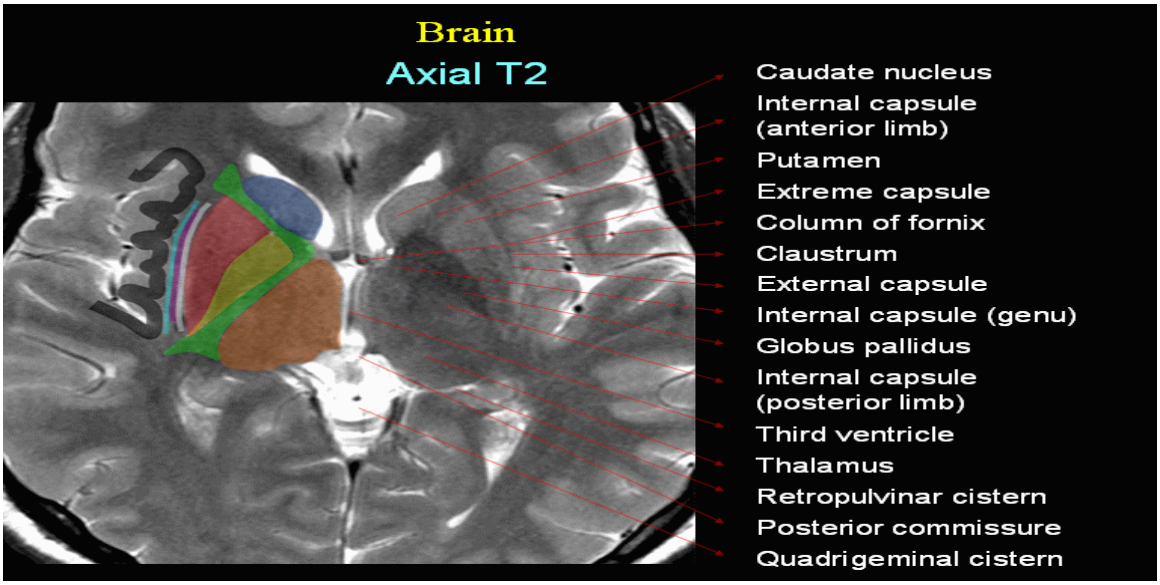


❖ Images

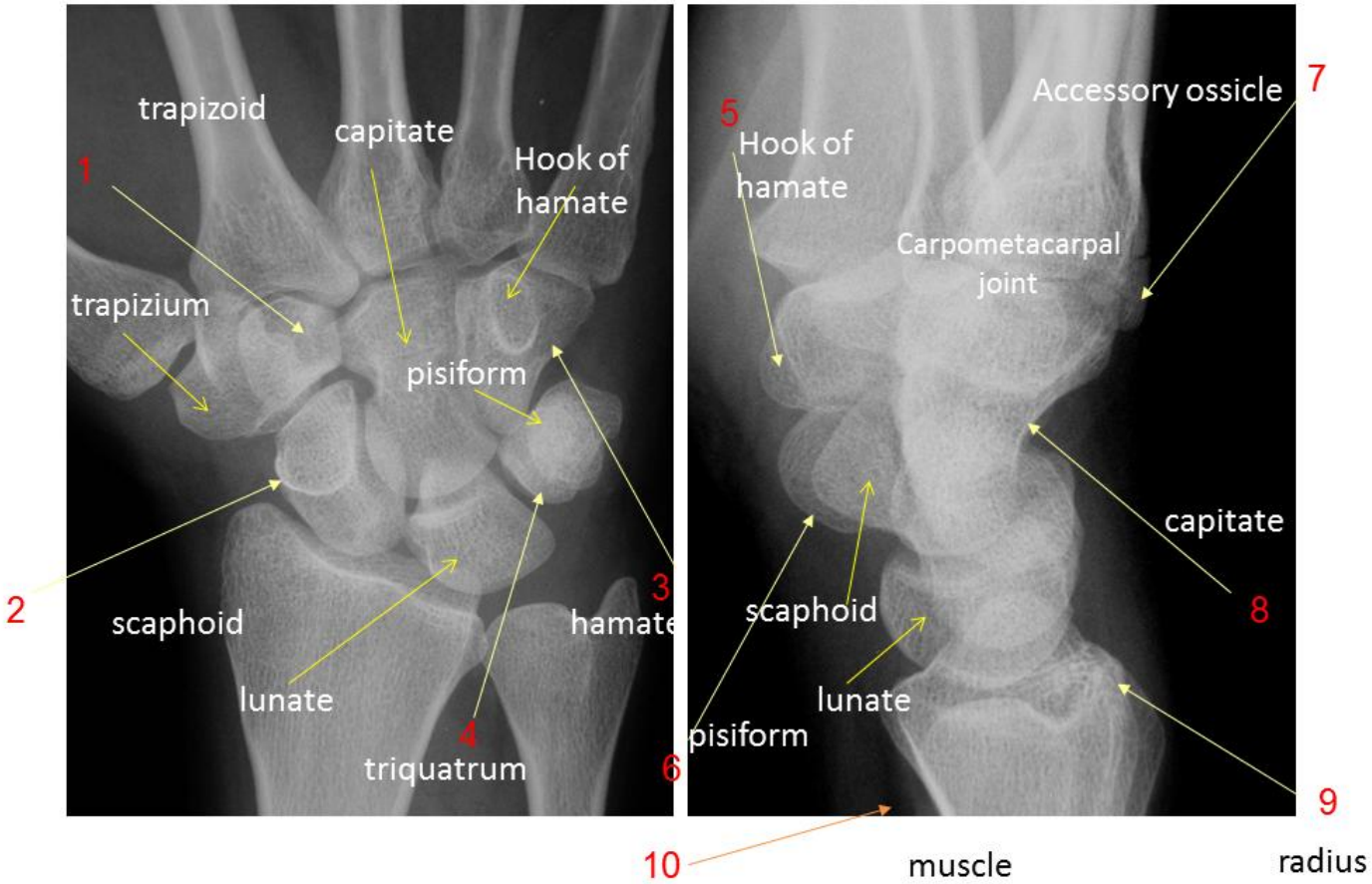
- **MRI of the brain**



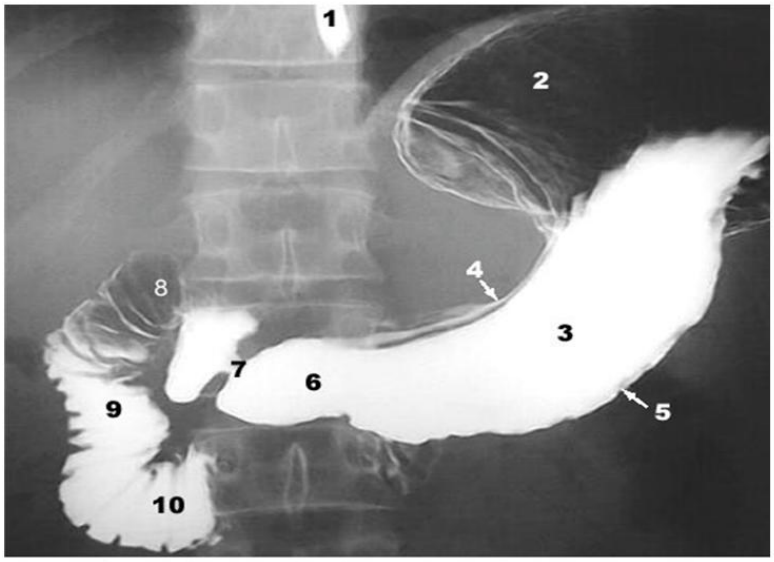




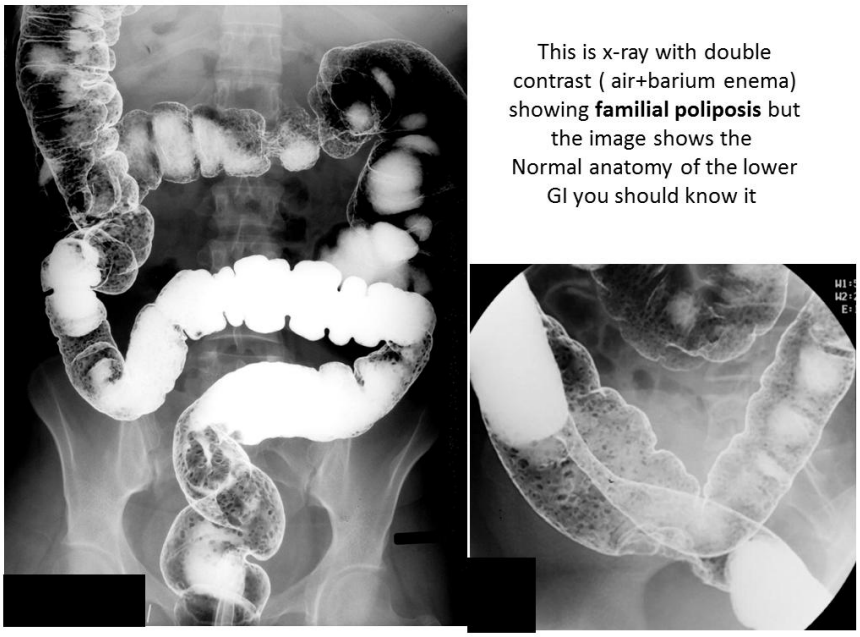
X-ray of normal carpal bones (you have to know them)



Normal anatomy of the upper GI



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



This is x-ray with double contrast (air+barium enema) showing **familial poliposis** but the image shows the Normal anatomy of the lower GI you should know it

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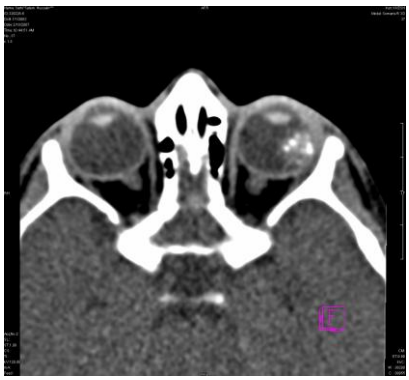
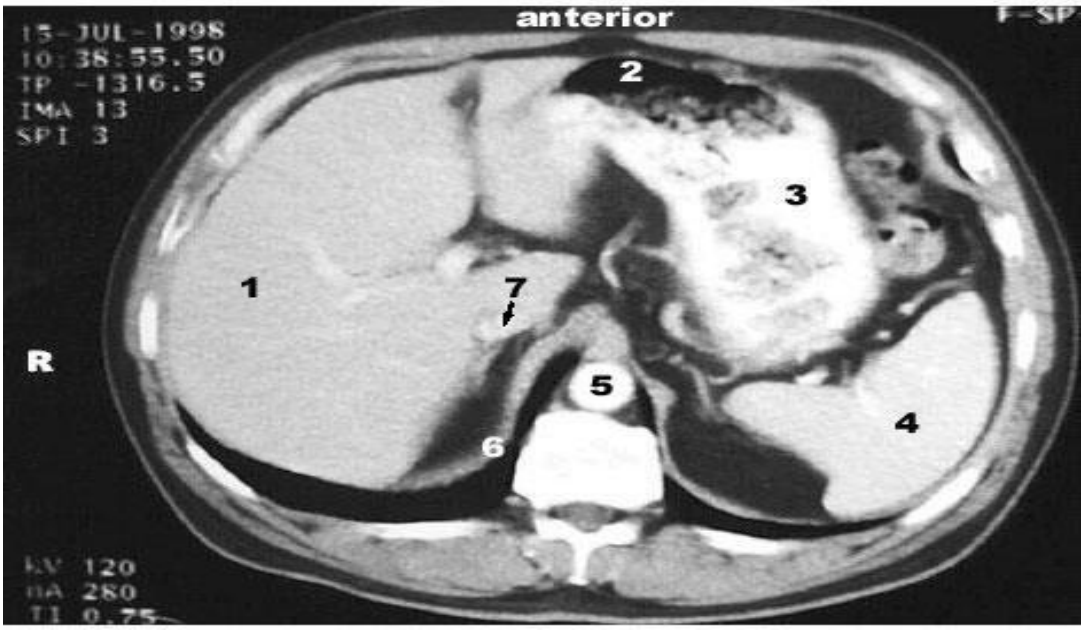


❖ **Leukocoria**

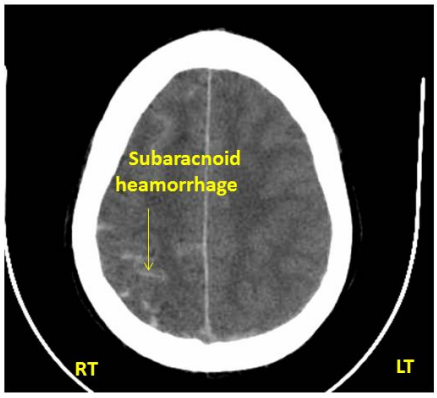
- CT scan, an axial cut of the orbit , abnormality is in the temporal aspect of the left globe partially calcified

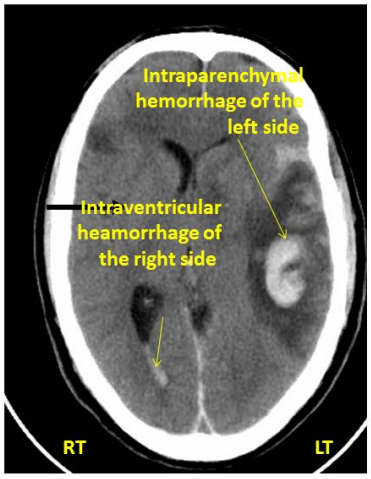
Diagnosis is retinoblastoma

- **Normal anatomy of CT scan of the abdomen**

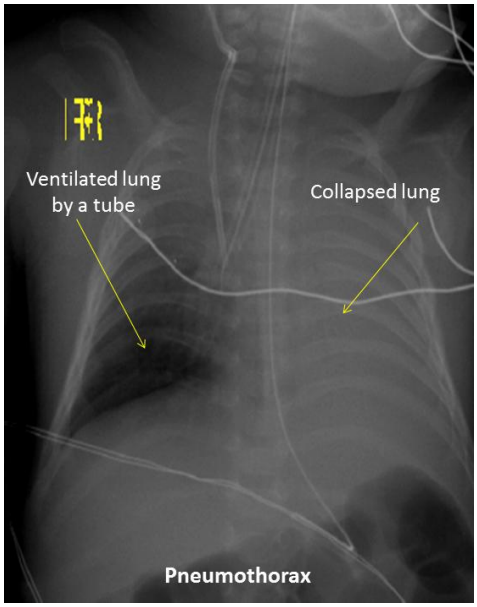


1 liver 2 gas in the stomach 3 stomach 4 spleen 5 aorta
6 crus of the diaphragm 7 inferior vena cava

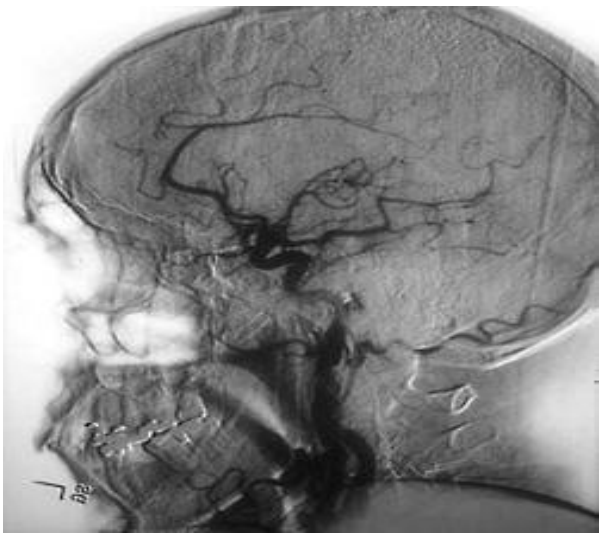


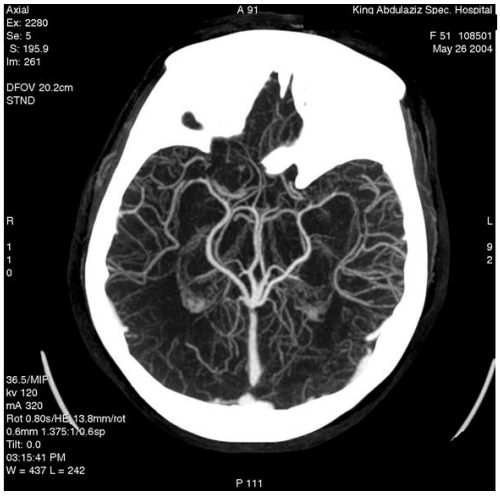


- CT scan of the brain **Subarachnoid hemorrhage**



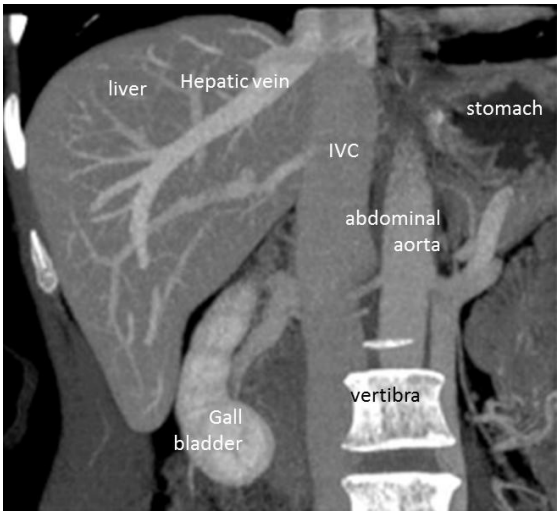
Pneumoperitoneum





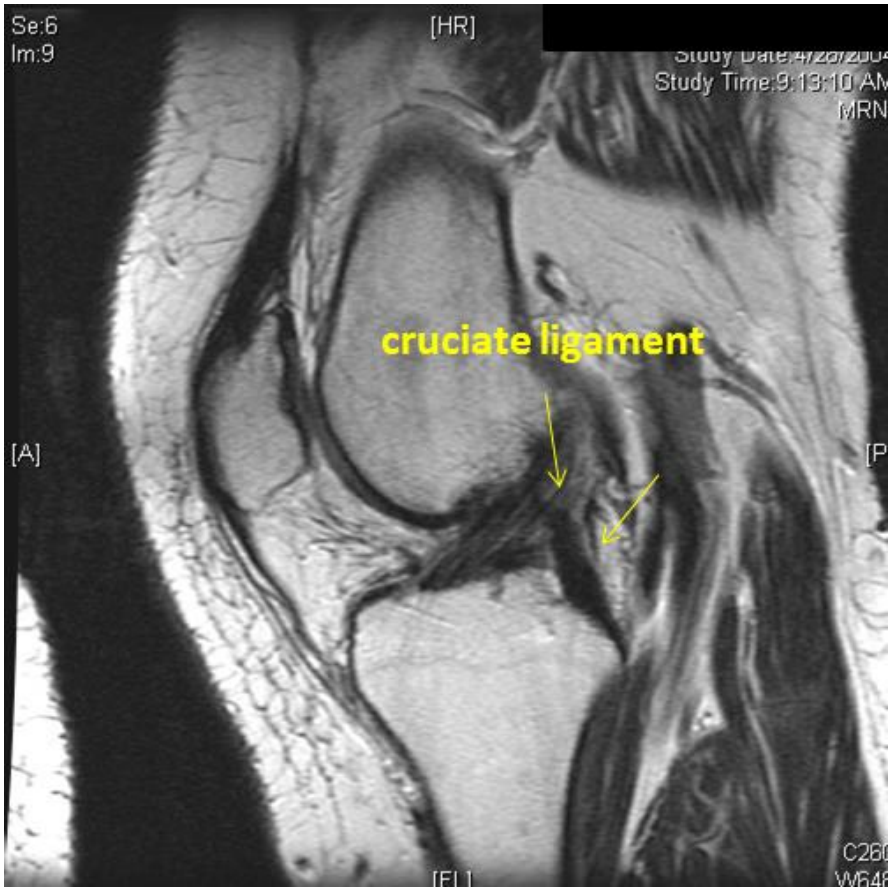
- Cerebral angiogram

- Right Coronary artery CT scan with contrast



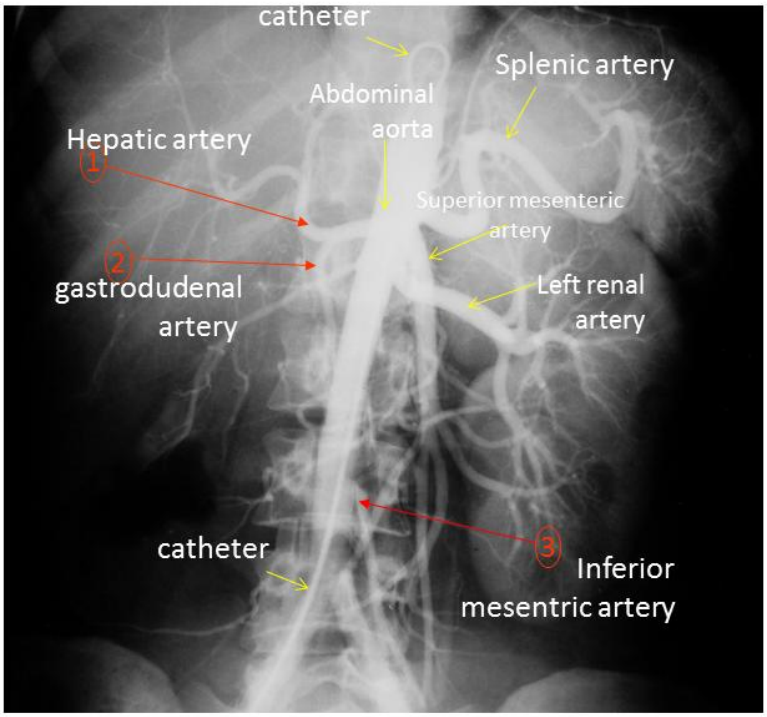
- CT scan of the abdomen with contrast

X-ray of the forearm of a pediatric patient (pediatric because we can see the growth plate),
Buckle fracture

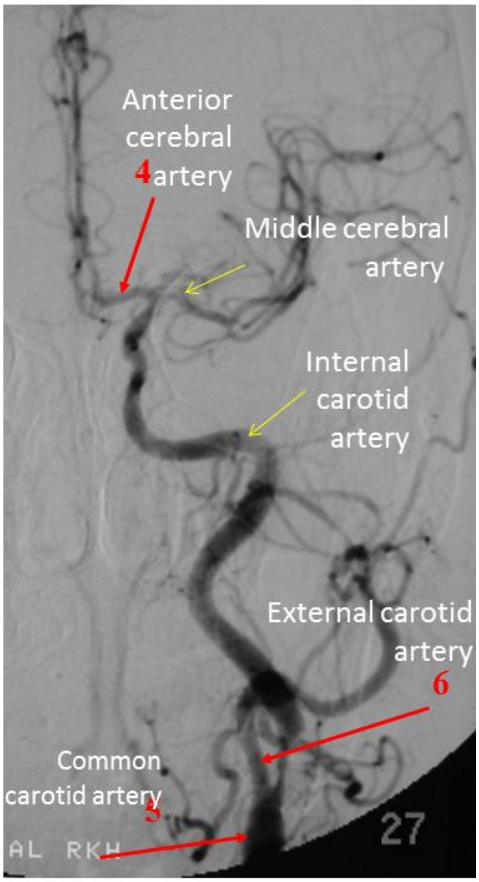


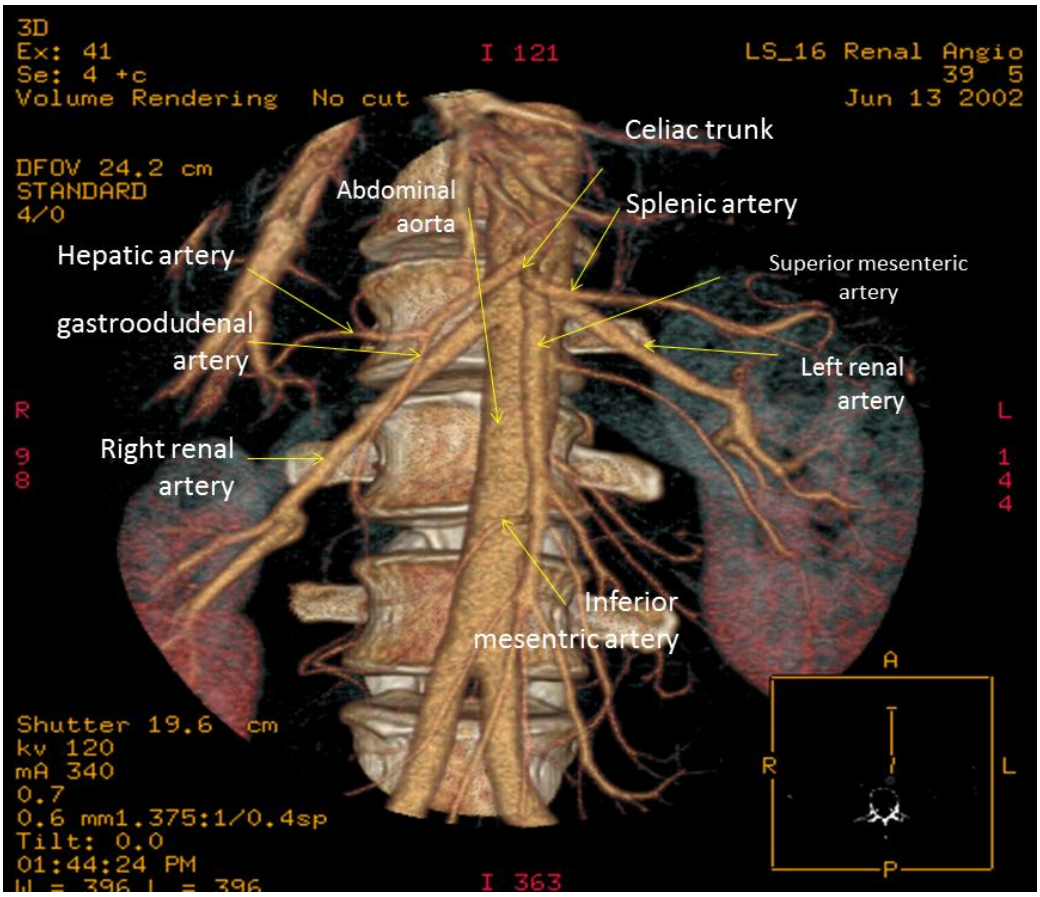
- MRI of the knee (normal)

Abdominal angiogram



Cerebral angiogram





- **3D CT scan of the abdomen**

❖ Summary

- 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
- CT scan can't be used for a pregnant women unless it is necessary
- MRI is contraindicated if there is Cardiac Piece makers or if there is any metal.