Radiology

Topics that Dr.Ammar ask about and are not included in this summary:
- Venogram: is an x-ray examination that uses an injection of contrast material to show how blood flows through your veins

- Sialogram: is the radiographic examination of the salivary glands. It usually involves the injection of a small amount of contrast medium into the salivary duct of a single gland, followed by routine X-ray projections

Some information about the contrast, and imaging:
- Gadolinium: is contraindicated in renal failure > causes nephrogenic systemic fibrosis
- Gastrogifin: is contraindicated in barium > risk of aspiration, chemical pneumonia
- NICM: is contraindicated in decreased kidney function (GFR)
- Barium Sulfate: is contraindicated in perforation
The contrast of **CT** scan is NICM
The contrast of **MRI** is Gadolinium

	White	Grey	Black
Ultrasound (echoic)	Hyperechoic	Hypoechoic	Anechoic
CT (dense)	Hyperdense	Isodense	Hypodense
MRI (intense)	Hyperintense	isointense	Hypointense
Xray	Radio-opaque		Radio-lucent

The Abdomen
X-Ray

- AXR Projections: 99% Supine, 1% Erect, lateral decubitus
- Film Specifies: Name, Age (DOB), Location, Date, Film number
- Technical factors: type of projection, any special techniques markings used

Black Bits (Air) > ***intraluminal***: its abnormal if in wrong place, or too much is seen
> ***extraluminal***: always abnormal
- max diameter in large intestine 55mm, in small intestine is 35 mm, caecum 80 mm
- in large intestine we have ***haustra***, in small intestine we have ***valvulae conniventes***
- ***cut off sign*** (collapsed distal, dilation proximal) is a sign of obstruction
- extraluminal gas (air under diaphragm) causes: Post-surgery (adhesions – e.g. ERCP, intra-abdominal surgery), perforation, gallstone, cholangitis, abscesses, and the image should be ***ERECT CXR***, how to make sure it's under the diaphragm, and not in the stomach? By taking a lateral image, CT, wait, or to give contrast (gastrografin)

White Bits (Calcification): it might be:
- abnormal structure > gallstones, renal calculi (15% of gallbladder, while 85% renal)
  normal structure, but represents pathology > nephrocalcinosis
  normal structure, harmless > LN calcifications

Grey Bits (Soft tissues): most of the organs in the abdomen are grey, but to diagnose we mainly depend on other techniques such as US, CT

Bright White Bits (Foreign bodies): clips, devices, pacemakers, etc..

we use X-ray for:
a. Bowel gas pattern
b. Stones or Calcification (radio-opaque)
c. Extraluminal free gas
d. Sign of intestinal obstruction
e. Skeletal abnormalities

Contrast medium for GIT:

a. Barium Sulfate: pleasant taste, taken orally, C.I. perforation

b. Gastrografin: orally, water soluble, taste is bad, used in:
suspected bowel perforation, post-op for leakage, meconium ileus
C.I: in barium swallow and meal if the pt is at risk of aspiration, because it can induce pulmonary edema, chemical pneumonitis (very very bad)

c. Nonionic contrast medium (NICM – omnipaque): IV, expensive, a bit sour taste, used in infants

Note: we only care about the allergy in the IV contrasts, not the orally taken contrast

Name	Region & info	Indications
Barium Swallow	to visualize the area from the mouth to the stomach (esophagus)	a. Symptoms of gastro-esophageal reflux b. Dysphagia, related to: Esophageal (Web, stricture, tumor, achalasia), vascular abnormalities
Barium Meal	Double contrast (gas+barium) to visualize the stomach and the duodenum	a. Gastro-edophageal reflux b. Gastric or duodenal ulcer c. Hiatus hernia d. Gastric tumors
Barium follow-through	To visualize the small intestine, taken every 1/2 hr till we reach the large intestine (stool white)	a. IBS (crohns mostly) b. small bowel tumor/lymphoma (filling defect) c. Small bowel obstruction
Barium Enema	Double contrast (barium + air), to visualize the colon, and it's the only contrast given in the rectum (by Folly's)	a. Abdominal mass b. Large bowel obstruction / volvulus c. Diverticular disease d. Colonic tumor

Small intestine obstruction:

- initial test is AXR
- Causes: adhesions (post-op, 70%), strangulated hernias, tumors of small bowel, IBS
- Radiological signs:

a. Dilation of small bowel loops (usually centrally placed)
b. Multiple air fluid levels
c. Absence of gas in the colon (if there is gas it is either recent, or incomplete)

	Small bowel	Large bowel
Distribution of loops	Central	Peripheral
Number of loops	Many	Few
Diameter	2.5 – 3 cm	5-7cm
Haustra	Absent	Present
Valvulae Conniventes	Present	Absent
Solid Feces	Absent	Present

Large Bowel Obstruction:

- AXR is useful, the proximal part is dilated, fluid levels are present / Causes are:

a. Colonic Ca

b. Diverticular disease

c. Volvulus of sigmoid colon

d. Paralytic ileus (causes both small, and large obstructions especially in post op)

Air Under Diaphragm (pneumoperitonium): can be under one or both diaphragms

- Lateral decubitus can be used in very ill patients, Causes are:

a. Post-op (labratomy, laproscopy)

b. Post peritoneal dialysis

c. Perforated viscus (most common cause): mostly from: perforated PU, perforated appendix (appendicitis), diverticulum rupture (diverticulitis)

Radiology of the liver, gallbladder, biliary system:

AXR for:

a. detection of radio-opaque calculi

b. Calcification of the liver, gall bladder wall

c. Gas in billiary tree

US for:

a. focal or diffuse disease of liver

b. staging primary tumors

c. detecting secondary deposits

- it also can visualize the gallbladder, CBD, hepatic and portal veins

CT for:

- full range of liver disease (cirrhosis & tumors)

MRI for:

- better than CT because no risk of radiation, with same quality

- blood vessels & bile ducts may be seen without injection of contrast by MRA (Magnetic resonance angiography) & MRCP (Magnetic resonance cholangiopancreatography)

Gallstones:
- Types: Cholesterol (80%), Pigment (Ca+2, billirubin), Mixed
- Causes: obesity, diabetes, cirrhosis, blood disorders (e.g. sickle cell anemia)
- AXR shows only 10%, US Is the best for gallstones (stones appear echogenic)

Acute Cholecystitis:
- inflammation of the GB (sudden, severe)
- on US:
a. Distended GB with stones
b. thickened edematous wall of GB (more than 3mm)
c. pericholecystic fluid (abscesses in severe cases)
d. Sonogrophic murphy sign

Acalculous Cholecystitis:
- rare, might be in hospitalized pt in cardiac intensive care due to ischemia

Endocropic retrograde cholangiopancreatography (ERCP):
- indications:
a. Obstructive jaundice
b. Removal of known CBD stones (by insertion of a catheter with a basket or balloon)
c. Pancreatic tumors (that cause BD obstruction and jaundice)
d. Malignant CBD strictures (can be stented)
- the contrast is injected into the ampula of vater to show the BD & pancreatic ducts

Chilaiditi syndrome: is a rare condition when pain occurs due to transposition of a loop of large intestine (usually transverse colon) in between the diaphragm and the liver, visible on plain abdominal X-ray or chest X-ray; it is one of the causes of pseudopneumoperitoneum (search for pictures of this syndrome on the internet)

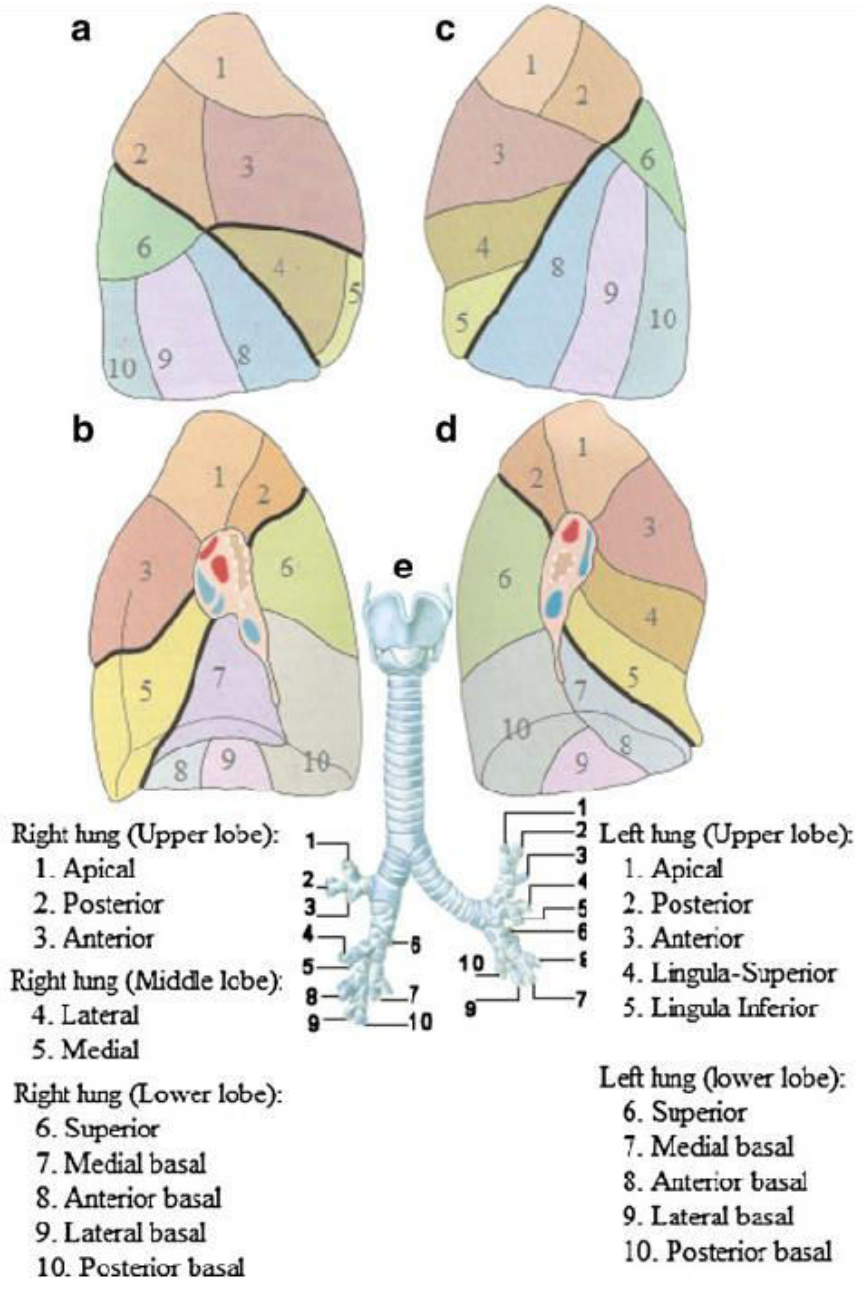
The Chest

- Routine CXR: PA & lateral
- why PA over AP?

a. less magnification of the heart
b. more lung fields
c. Scapula away from lung fields
d. Apices are closer so more clear, and clavicles away from the apex

- we use AP: in very ill pt, and infants, and small children
- we use inspiration-expiration films: in foreign bodies aspiration, and pneumothorax
- when reading an X-ray you should check, request form (name, age, sex, date, clinical info), and technical factors (markers, centering, degree of inspiration, exposure)

Anatomy of lung segments (Common Question):



Pneumonia:
- inflammation of the lung (causes by many micro-organisms), it might be lobar pneumonia or bronchopneumonia (hilar region mostly), it also might be primary or secondary (as in lymphoma)
- with ttt. Bacterial 2 weeks, viral longer (month), mycoplasma (4-6 wks) to resolve, if they are not resolved then we do a CT or Bronchoscopy

Pulmonary Collapse (Atelectasis): (lung = more opaque)
- decrease in volume of lung, lobe, segment
- most common cause is obstruction (due to bronchial carcinoma, mucus plug, foreign body, IBD, extrinsic compression by tumor or enlarged LN)

Emphysema:
- Radiological signs:
a. lung is more translucent
b. reduction in size number of small vascular markings
c. the diaphragm are low and flat
d. heart shadow is long and narrow
e. postero-anterior diameter of the chest is increased on lateral view (barrel chest)

Pleural Effusion:
- collection of fluid in space between the parietal and visceral layers, it might be: haemothorax, empyema (pus), hydropneuymothorax
- Radiological signs:
a. Homogenous ocification
b. Loss of the diaphragm outline.
c. No visible pulmonary or bronchial markings.
d. Concave upper border which appear higher laterally.
e. blunting or obliteration of the costophrenic angle.

Pneumothorax:
- free air in pleural space by a tear in either parietal or visceral pleura
- the most common cause is chest injury, but the most common cause of spontaneous pneumothorax is rupture of sub-pleural emphysematous bullae (bleb)
- Radiological signs:
a. lung edge: thin white line represents the visceral pleura
b. absent lung markings
c. mediastinal shift: occur when tension pneumothorax develop

Solitary Pulmonary nodule:
- it must be:
a. nodular or roughly spherical
b. <3cm (if >3cm then it's a mass not a nodule)
c. 40% of solitary pulmonary nodules are malignant
d. a nodule is assessed for its: size, margins, calcification
- Causes of solitary pulmonary nodule: bronchial Ca, METS, hamartoma, adenoma, granuloma, abscess, hydatid cyst, bronchogenic cyst, AVM, rheumatoid nodule

The Mediastinum:
- it can be divided into 3 parts: Anterior, middle, posterior (by the pericardium)
- Anterior mediastinal masses:
4 Ts: terrible lymphoma, thyroid, teratoma, thymic tumor & pericardial cyst, diaghramatic hernia (morgangi hernia)
- Middle mediastinal masses:
a. LN enlargement (lymphoma, primary TB, sarcoidosis),
b. Bronchogenic cyst,
c. Aneurysm of aortic arch
- Posterior mediastinal masses:
a. Neurogenic tumors (neurofibroma, ganglioma)
b. Aneurysm of descending aorta
c. Hiatus hernia (bockdalek hernia)
d. Dilated esophagus (specially achalasia)
e. Paravertebral mass or abscess

Tumors of the lung:
- lung Ca is the commonest fatal malignancy, it has a strong relation with smoking
- 95% of the malignant T arise from respiratory epithelium (bronchogenic Ca), less than 5% of rare cell types (lymphoma, METS)
- types of lung Ca:
a. Adenocarcinoma:
- the most common 30-40%, it arise peripherally as solitary pulmonary nodule
- the alveolar cell Ca is a subtype that arise within the alveoli, producing areas of consolidation and the appearance of bronchopneumonia

b. SCC:
- typically in central bronchi
- it grows slowly and cavitate more often than other cell types

c. Small (oat) cell Ca:
- central in location, fastest rate of growth
- associated with mediastinal adenopathy

d. Large cell Ca:
- peripheral in location, with rapid growth rate

Benign tumors of the lung:
a. Hamartoma:
- most common benign, mostly solitary, well defined, rounded mass
- calcification (popcorn) is present in 40% of cases), and fat in 50% of cases

b. Adenoma:
- occur around the hilum as round well defined nodule mostly

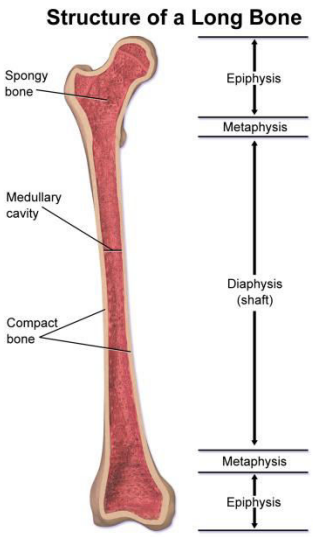
Lung METS:
- commonest primary tumors producing lung mets are: breast, renal tract, thyroid, bone, testicular tumors
- METS are well defined spherical, multiple, bilateral, more peripheral in location

Chest Trauma:
- can be blunt or penetrating
- most common clinical problems associated are contusion, pneumo/hemothorax
- fracture of lower ribs associated with diaphragm, spleen, liver injuries
  of upper ribs associated with great vessels injuries
- we approach with ABCDE:
A> air/B>bone/C> contusion& laceration / D> diaphragm / E> effusions (hemothorax)

Dextrocardia: is a rare congenital condition in which the apex of the heart is located on the right side of the body

Situs inversus is a congenital condition in which the major visceral organs are reversed or mirrored from their normal positions. The normal arrangement of internal organs is known as situs solitus while situs inversus is generally the mirror image of situs solitus

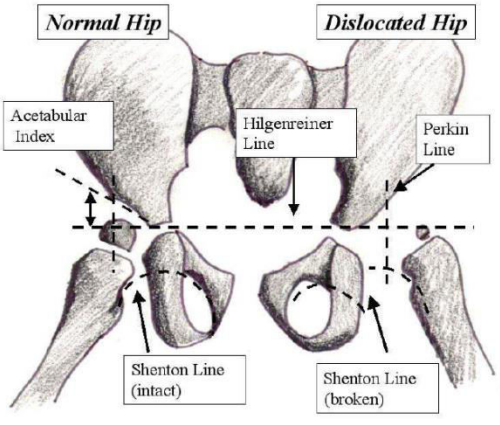
Skeletal System



Epiphysis: is the rounded end of a long bone
Metaphysis: the narrow part of a long bone btw epiphysis & diaphysis
Diaphysis: is the main or midsection (shaft) of a long bone

Imaging:
- **X-ray** investigation of choice for skeletal system (2 views AP/lateral)
- initial X-ray, best is CT
- but we use **US** in:
a. Congenital Hip Dislocation
b. Abscesses & soft tissue lesions
c. Joint effusion (in suspicion for bakers cyst)
- and **CT** is helpful in:
a. Spinal column
b. Certain fractures (acetabulum, spine, calcaneum)
c. Bone tumor prior surgery
- **MRI** helpful in: injuries to cartilage, ligaments, meninsci, and tendons
a. tumors
b. soft tissue masses
c. joint

Congenital Hip Dislocation (CHD): occurs when a child is born with an unstable hip.
It's caused by abnormal formation of the hip joint during fetal development
- it is determined by 3 lines:
1- Perkin line (mainly the diagnostic one):
2. Shenton line: line between medial aspect of neck of femur to medial aspect of obturator foramen
3. Acetabular index: if more than 27 there's CDH



Osteoarthiritis:
- degenerative condition, normal ageing process
- might be primary or secondary (from trauma, infection)
- most affected parts are the knee, hips, shoulders
- Radiological features:
a. Osteophyte formation
b. Joint space narrowing
c. Sclerosis
d. Loose bodies

Osteomyelitis:
- infection of the bone, most commonly due to Staph Aureus
- Radiological features: in the first 10-14 days its normal
a. Soft tissue swelling due to edema (earliest sign)
b. Periosteal reaction (saw like outlines – irregular)
c. Bone destruction
- most common site Is the lower limb then the vertebrae
- osteomyelitis & METS have the same signs

Rickets: (check images on the internet for this one)
- is a condition that results in weak or soft bones in children
- Radiological signs:
1-cupping of epiphysis of ulna and radius.
2-epiphyseal plate widening.
3-Fraying of the metaphysis.

Multiple Myeloma (Plasma cell cancer - malignant):
- appears as a lytic black lesion, might be disseminated or localized solitary (plasmacytoma)
- mostly occurs at the skull, spine, rips, pelvis
- Radiological signs:
unlike osteomyelitis at the time of presentation 80% you have abnormalities
a. Generalized osteoporosis (weak fracture prone bones)
b. Scattered lytic lesions (well defined)
c. Compression fractures of the vertebral bodies

Bone Metastasis (METS):
- most common malignant bone tumor
- mostly from the breast, thyroid, prostate, lung, kidney, adrenal glands (all tumors are lytic, except from the breast (mostly lytic), and from the prostate (sclerotic))

Skeletal Trauma:
- initial evaluation is X-ray, unless to head or spine then CT is initial test (because CT can detect fractures, intracerebral hemorrhage, contusions)
Fracture: is a break in the bone continuity of bone or cartilage
- the fracture is either closed (skin intact) or open (skin penetrated)

Types of fractures:
a. Linear
b. Comminuted: fracture into numerous pieces
c. Avulsion
d. Pathologic
e. Greenstick: mostly radius in children
f. Stress: including the March fracture – for the 2nd & 3rd metatarsal bones
g. Depressed: mostly in the Skull
h. Compression: mostly in the spine
i. Boxer fracture: at the base of 4th or 5th metacarpal bone

Spinal Injuries: classified into 3 types:
Compression, Burst, Fracture - Dislocation
we care if wither they are stable or not (depending on the SC)

Benign Bone Tumor	Malignant Bone Tumor
Well defined thin transitional zone	Wide transitional zone
Thinning of the cortex only, less destruction	Destructive lesion
Has a Sclerotic Margin	Periosteal reaction
E.g. *Non-ossifying fibroma* *Chondroma* *Osteochondroma* *Osteoma* *Ostoid osteoma* *Osteoblastoma* *Simple bone cyst* *Aneurysmal bone cyst* *Haemangioma*	E.g. *METS* (most common – mostly solitary) Primary: (Age-related) *Osteogenic sarcoma* *Ewings tumour* *Chondrosarcoma* *Fibro sarcoma* *Giant cell tumor*

- **CT/ MRI** are better to use in tumors (specially malignant), because of the soft tissue, they can visualize:
a. tumor vascularity
b. infiltration of the surrounding (invasion)
c. relationship with nerves and blood (METS)

The Urinary Tract

Xray:

a. renal calculi or calcification
b. ureter stones
c. bladder calcification
d. bone abnormalities or METS

US:

- investigation of choice in children

a. renal size
b. masses
c. renal obstruction
d. bladder RV
e. prostatic size

CT:

a. renal masses
b. obstruction
c. retroperitoneal disease
d. staging of renal & bladder neoplasm
e. tumor invasion into the renal vein or IVC (at this stage pt is inoperable)
f. evaluation after trauma or surgery

MRI:

- used when there is renal mass or abscess is suspected but IV contrast (NICM) cannot be administered, because of either contrast allergy or abnormal renal function, in this case MRI can be performed
- The Gadolinium is the contrast agent used in these circumstances, but gadolinium might cause nephrogenic systemic fibrosis in pt with RF
- so in abnormal kidney function NICM is CI, but in RF gadolinium is CI

Urinary tract calculi:

- 90% Ca+2 (radio-opaque on X-ray), uric acid (radiolucent), cystine (semi-opaque)
- initial imaging is KUB
- do not mistake with other calcifications such as phelobolith (venous calcification) it has a lucent center
- CT without IV contrast is the most sensitive for UTS, and all stones appear on it

IVU/IVP (intravenous urography/pyelography):

- indication:

a. hematuria
b. renal colic
c. stone in ureter
d. renal trauma

- films are 5,10,15 min (1cc = 1kg / till 100 kg), & post micturition film is taken for RV

Note: how much dose is given in the IVP?
- for each 1 kg we give 1 cc in adults
- for each 1 kg we give 1.5 cc in infants
- the max cc that can be given is 100 cc, so if someone weights 100 kg he will be given 100 cc, if he weights 140 kg he will also be given only 100cc (bcuz 100cc is the max)

Micturating Cystogram (MCUG):
- study of bladder and urethra with contrast (via catheter), then pt asked to void after catheter is removed and the films are taken during micturation to asses bladder, urethra, and refluxes, it is important to examine the urethra in oblique position

Note: how to differentiate between IVP & MCUG on an X-ray image?
1. In IVP images there is time written on the picture (because its given several times)
2. In MCUG there is a catheter in the picture

Urethrogram:
- for adult male urethra, contrast is injected by a catheter and a balloon is inflated with 1-2ml of sterile water placed in the navicular fossa, and films are taken in oblique position during contrast injection
- the most common indication is urethral strictures (in west STDs, in east: instrument)

Urinary Tract Obstruction:
- most common causes are:
a. stones b. strictures c. tumors d. prostatic hypertrophy or cancer
- over time, obstructed kidneys might lose function, so we need to recognize it
- the best initial imaging for renal obstruction is US

Benign renal lesions:
- the most common renal mass is simple cyst (common in elderly, mostly incidental)
- best way to confirm a renal mass is a cyst is US (well defined round with then wall, and smooth margin and no internal echoes)

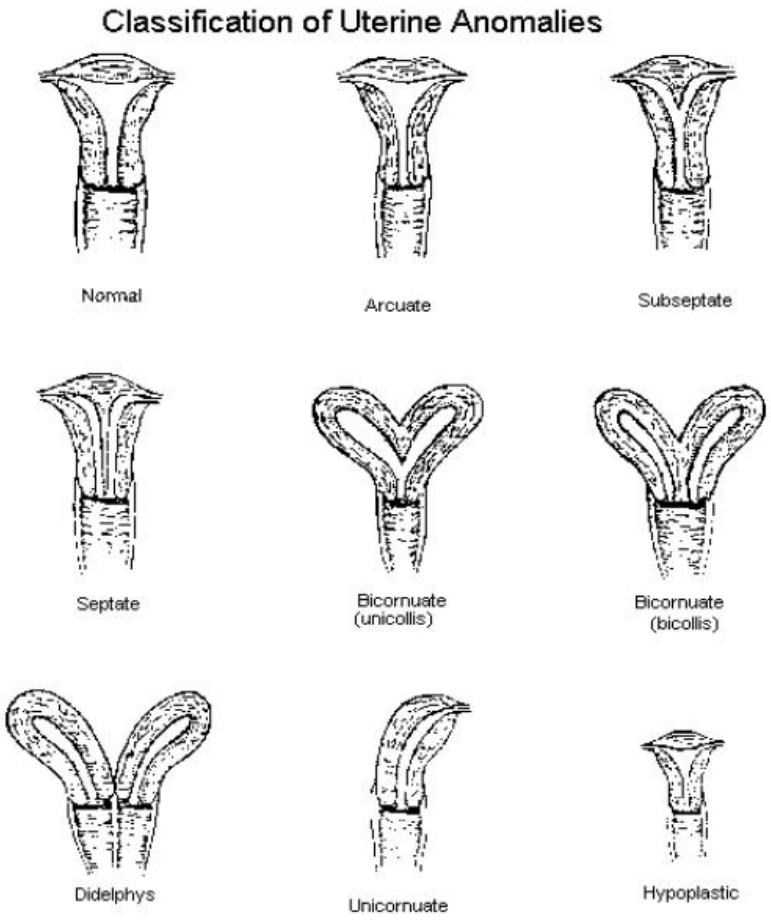
Polycystic kidney disease (PCKD):
- congenital parenchyma disorder, mostly in both kidneys, even other organs (liver)
- differentiated between the hydatid cyst: by knowing that hydatid cysts are calcified with water lily sign
- Radiological findings:
a. enlarged kidneys with lobulated contour
b. renal parenchyma is replaced by cysts of varying size, causing distortion of CS
c. spontaneous hemorrhage into some cysts might occur

Duplicated Ureter: or Duplex Collecting System:
- is a congenital condition in which the ureteric bud, the embryological origin of the ureter, splits (or arises twice), resulting in two ureters draining a single kidney (check for images on the internet)

Neurogenic bladder dysfunction:
- sometimes simply referred to as neurogenic bladder, is a dysfunction of the urinary bladder due to disease of the central nervous system or peripheral nerves involved in the control of micturition (urination). Neurogenic bladder usually causes difficulty or full inability to pass urine without use of a catheter or other method
- on images: the bladder is elongated, with irregular borders

Malignant renal tumors:
RCC ((Renal cell carcinoma)) or hydronephroma):
- account for 85% of renal T, 4% bilateral
- associated with Von Hippel- Lindau in 1/3 to 1/2 of pt, and also with PCKD, RF pt
TCC (transitional cell Ca):
- rare 7% of renal tumors

Hysterosalpingography (**HSG**): is a radiologic procedure to investigate the shape of the uterine cavity and the shape and patency of the fallopian tubes. It entails the injection of a radio-opaque material into the cervical canal & usually fluoroscopy with image intensification. A normal result shows the filling of the uterine cavity and the bilateral filling of the fallopian tube with the injection material. To demonstrate tubal rupture, spillage of the material into the peritoneal cavity needs to be observed



Neuroradiology – Brain imaging

X-Ray
- shows: calcification, enlargement of pituitary fossa, bone lesion, fractures

US:
- the neonatal is scanned through the open anterior fontanelle for:
a. hydronephrosis
b. interventricular or intracerebral haemmoraghe
c. intracranial pathology
- Doppler studies are used for the diagnosis of carotid artery stenosis
- Note: Craniosynostosis: when the sutures are prematurely closed

CT:
- for acute head injury (recent hemorrhage), stroke, SAH

MRI:
- has a multiplanar facility, with excellent views for the posterior fossa
- MRI is superior to CT in:
a. Acute ischemic stroke
b. Lesions of the pituitary fossa
c. Spinal cord abnormalities
d. White matter disease
e. Demyelinating plaques in multiple sclerosis
f. Differentiation of grey and white matter

Angiography (CT):
- for AVM, and Aneurysm, but is being replaced by MRA

Skull fracture:
- categorized as linear or depressed
- most clinically significant is the paranasal sinus or skull base is involved

Brain infaction:
- the main sign is a hypodense area (decreased attenuation) within the cerebral substance with effacement of sulci
- hemorrhage may develop within the infarct (10-15%) which is seen as a hyperdense
- the most commonly affected is the meningeal artery
- Lacunar infarction: small (usually <1cm), deep cerebral infarcts (of small distal intracerebral arteries), and mostly appear at the area of basal ganglia (because its commonly seen in elderly with hypertension)
- in brain infarction: CT is superior to MRI in detecting recent hemorrhage, and intracerebral hemorrhage (which is an ER so needs to be fast), while the MRI is superior than CT in evaluation any kind of edema, and acute infarctions

Brain hemorrhage:

Intracerabral hemorrhage:

- caused by a rupture of blood vessel, most commonly at the basal ganglia, thalamus, and cerebellum
- 1/3 of ICH result in intraventricular H
- most common causes: Chronic hypertension, and ruptures aneurysm or AVM

Intracranial hematomas head injury:

a. Intra-parenchymal hematoma:

b. Epidural hematoma:

- mostly (90%) due to arterial injury (mostly the meningeal artery – thus temporo-parietal are the most commonly affected)
- on CT: biconvex or lenticular, hyperdense lesion

c. Subdural hematoma:

- mostly due to a venous injury (usually a tear in the bridging cerebral veins**)**
- less compression on the brain (crosses the sutures)
- on CT: cresent-shaped, with concavo-convex configuration

d. Subarachnoid hematoma (SAH):

- H into the CSF spaces, and frequently in acutely injured patient
- mostly due to a penetrating injury, rupture aneurysm, systemic hypertension
- appear as hyperdensities filling the CSF spaces (cisterns, sulci, sylvian fissure, interhemispheric fissure)

Cerebral Contusion:

- bruising or crushing of brain tissue
- two types: hemorrhagic (may not be evident in the very acute stage or the 1st 24 hr), and nonhemorrhatic (necrotic)

Multiple Sclerosis (MS):

- is a white matter disease, destroying the myelin sheath (fatty layer)
- demyelinating lesions (plaques) with a relapsing & remitting course
- mostly in young females
- MRI is study of choice: MS appear hyper-intense on T2, if taken the contrast enhancement, that means its and active disease
- the most common location are in the periventricular region, corpus callosum

Brain Tumors:

Primary: are classified into

Intra-axial: in the brain parenchyma:

Gliomas:

- more than 50% of primary intracranial T, and it include:

Astrocytomas:
- classified from I (mostly in young) – IV (glioblastoma multiforme –mostly in elderly)
- the more the grade the less the calcification
- differentiated from a Cyst by the contrast enhancement (a cyst wont take it)

Ependymomas
Oligodendrogliomas

Cerebellar tumors:
in adults:
- the most common cerebellar lesion Is METS, and the 2nd is hemangioblastoma

in children:
- the most common malignant is medulloblastoma, then astrocytoma, ependymoma, brain stem glioma

extra-axial: in the meninges and cranial nerves
- the common extra-axial tumors are: meningiomas, neuromas, METS, primary T

Meningiomas:
- 15-20% of the primary brain T, benign, well defined, arise from the meninges
- most commonly in the parasagital region and sphenoid wing
- small punctuate calcifications can be seen (25%)
- CT or MRI: showed well defined lesions that enhance strongly and diffusely after IV contrast because it is a vascular T and on MRI we might see the meningeal tail for the artery that supplies it

Pituitary T:
- on Xray we can see pituitary fossa enlargement or erosion
- adenomas <1cm are micro, and >1 cm are macro
- MRI is better than CT in adenomas

Acoustic neuroma:
- arise in the internal auditory canal (might cause widening, erosion of the canal)
- MRI is also more sensitive than CT

Brain METS:
- mostly are multiple, most common site is the junction btw the white-grey junction
- mostly its surrounded by edema, and commonly comes from bronchial, breast, GI T

Neuroradiology – Spine imaging

- we have 33 vertebrae (7,12,5,5)
- the vertebral column contain: SC, meninges, associated vessels
- the SC is 45 cm long, that ends with the conus medullaris between L1-L2, and the cauda enquina (formed by spinal nerves) extend to the level of S2

Developmental anomalies of the lumber spine:

Sacralization or lumbarization
Spina bifida: defect in closure of the SC (if small no effect, if large myelomeningocele)
Synostosis (block vertebra): fused vertebrae, most commonly in the cervical region
Hemivertebra: might lead to scoliosis
Butterfly vertebra: might lead to scoliosis
Myelomeningocele: its an ER that should be closed
Tethered cord: when the conus medullaris is abnormally low and tethered
Diastematomyelia: congenital division of the spinal cord into 2 cords [most commonly thoracolumbar], They may fuse again or remain 2 cords

Spondylolisis:

- defect at the pars interarticularis region, most commonly the 4^{th} & 5^{th} lumbar lvl
- almost always thought to be the result of unhealed stress fracture

Spondylolisthesis:

- anterior slipping or subluxation of a vertebra over another, main causes are:

a. Spondylosis (most common cause)
b. Degenerative disc disease, osteoarthiritis
c. fracture of the posterior element of the vertebra

Intervertebral disc pathology:

- most common articular disorders are: Degenerative disc disease, Disc bulging & hernia, infection (discitis, osteomyelitis)

Degenerative Disc Disease (DDD):

- not a disease (ageing process), most common cause of lower back pain
- it is characterized by:

a. Disc space narrowing
b. Osteophyte formation
c. Sclerosis
d. in some cases: collection of gas in intervertebral disc (vacuum disc phenomenon)

Disc Herniation:
- a portion of the nucleus pulposus extends through annulus fibrosus (protrusion)
- 90% are in L4-L5 & L5-S1
- types of disc herniation: prolapsed, extrusion, sequestration:
a. **Prolapse**: extends through a tear in some fibers but still confined
b. **Extrusion**: complete tear, extend either up or down, but still attached to disc
c. **Sequestration** (free fragment): complete tear, and penetrates the PLL (posterior longitudinal ligament) within the epidural space, into the neural foramen as a separate fragment
- the more the central the more the narrowing in the SC (spinal cord)
- X-ray: it cannot detect a disc herniation but it can exclude other pathologies that causes lower back pain, such as:
a. DDD b. Sacralization c. osteoarthiritis d. spondylosis/spondylolisthesis e. Tumor

Lumber Spine Tumors:
- Classified into 2 groups: bone tumors, and spinal cord tumors:
a. Tumors of the bone:
- Hemangioma of Vertebral body: appear hyperintense in both MRI T1/T2
- Osteoid osteoma
- Osteoblastoma
- Aneurysmal bone cyst
- Histiocytosis x (Eosinophilic granuloma)
- Multiple myeloma (found in the bertebral bodies)
- Metastasis (found in pedicles)

b. Tumors of the spinal canal:
I. Intramedullary (inside the cord):
- Ependymoma
- Astrocytoma
- Lipoma
II. Extramedullary-intradural: within the meninges:
- Neurofibroma & Schwannoma
- Meningiomas
- Dermoid & epidermoid
III. Extradural: btw the meninges and bone
- METS
- Meningioma