Basics of Investigation

RADIATIONS

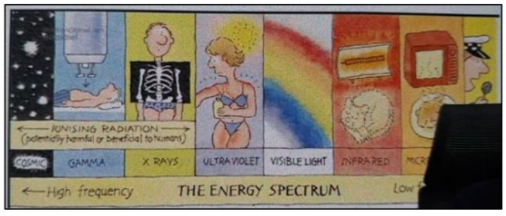
02:01

1) Ionizing
   - Any radiation capable of making the particle charged or ionized
   - Eg:
     i. Photons (no mass & charge) : X-rays, γ-rays
     ii. Particle (finite mass) : α-rays, β-rays

2) Non-ionizing
   - Any radiation which does not have this capability i.e, making the particle charged
   - Eg:
     i. UV rays
     ii. Visible light
     iii. Infra-red rays
     iv. Microwaves
     v. Radiowaves

- In general ionizing radiation are more harmful in comparison to non-ionizing radiation

- Energy associated with any radiation can be transferred to matter
- This transfer of energy can remove electrons from the orbit of atoms leading to the formation of ions



- $E = h\nu$
  - E - energy
  - h = Plank's constant
  - ν - frequency

- Radiowaves → cosmic waves
  - As the frequency increases, energy increases (or)
  - Capability of removing the electron increases (or)
  - Ionizing power increases

IONIZING RADIATION 03:57

- It can be
  a) Electromagnetic (or)
     i. X-ray
     ii. Gamma rays
     iii. Cosmic rays
  b) Particulate
     i. Electron (e)
     ii. Proton (p)
     iii. Neutron (n)
     iv. Alpha particle - highest mass (highest ionizing potential), highest damaging power

- Photon - no mass & charge
- Particle - variable mass and charge

- X-rays (extranuclear) & gamma (intranuclear) rays do not differ except in the source
- Proton exhibits a Bragg peak

- Ray with highest penetrating power → ν rays
- α rays :
  - damaging power
  - Highest ionization potential
  - Highest mass
  - Highest biological effect
  - Linear energy transfer

Basics of Investigations

Topic Notes: 4

RADIOLOGICAL INVESTIGATIONS *05:56*

Ionizing	Non-Ionizing
γ-rays → nuclear scan • PET • Bone scan • Thyroid scan • DTPA • Thallium • T_c based scan X-rays • Radiography • CT scan • Mammography • Angiography • MCU • HSG • IVP • RGU • DEXA - Dual Energy X-ray Absorption Machine	• MRI • USG • Thermography

INVESTIGATIONS *07:44*

INVASIVE	NONINVASIVE
• Laparotomy - maximum invasive • Minimally invasive : Laparoscopy, arthroscopy, catheter, angioscopy • Micro invasive : CECT, CT angiography, CEMRI, PET [do not consider them as invasive]	• USG

TERMS TO BE AWARE BEFORE PRESCRIBING ANY TEST *09:12*

- First investigation → done first → patient came with symptoms → Dyspnea, hematemesis, cough
- Screening test → rule out a disease

Basics of Investigations

Topic Notes: 4

- Investigation of choice → to confirm a disease

Symptom		+	-
Risk Factor	+	Confirm investigation of choice	Rule out screening
	-	Rule out screening	X

- **Best investigation** : Gold standard or Investigation of choice
- **Gold standard** : Final word
  - If it says no disease, then no disease
  - If it says there is a disease, then there is disease
  - We do not take into consideration of the
    - Risk
    - Cost
    - Side effects

NEXT INVESTIGATION *12:26*

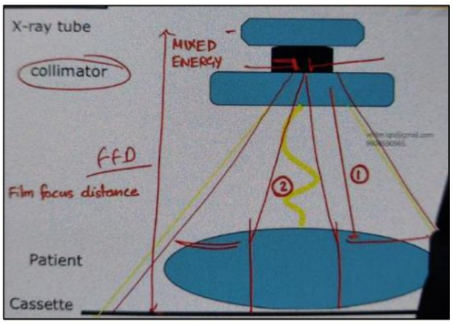
- A 50 yrs old patient presented with dysphagia, what is the next step management of the patient
  - NEXT investigation : Barium swallow
    ↓
  - Shows irregular narrowing

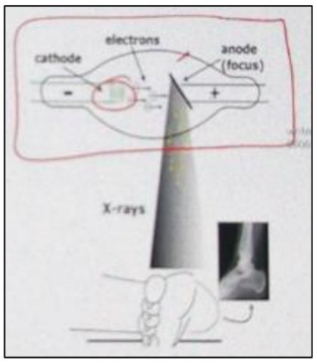
- NEXT investigation / most appropriate step

Basics of Radiography

X-RAY BASED INVESTIGATION

00:21

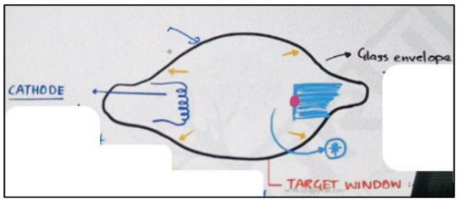




- Parts of X-ray tube
  1) Glass envelop
  2) Cathode
     - Filament
     - Supporting wires
     - Focusing cup
  3) Anode
     - Stationary
     - Rotating

Basics of Radiography

Topic Notes: 5

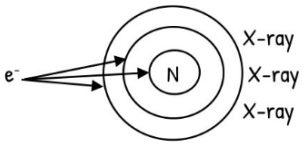


- Pyrex glass : provides a protected and vacuumed environment to the tube
- Target window (thinning of glass) : part where X-rays come out
  - In mammography it is made up of Berillium

- Cathode
  - -vely charged electrode
  - Most important part - filament (made up of tungsten)
  - Filament emits electron on passing the electricity
  - It is known as thermionic emission
  - Thorium : added to increase the stability for filament

- Anode :
  - Positively charged electrode
  - Most important part - target
    - Plate in the center of anode
    - It is made up of tungsten
    - It receives electron & generate -rays
  - Anode is made up of copper

- Electrons are travelling from cathode → anode
- Reaction - thermo-ionic



- Bremstrong reaction : interaction of the nucleus with e^-
- Characteristic radiation : interaction of e^- with orbit / shell
- Both are responsible for generation of X-ray

- Bremstrong reaction is most important in all radiation except in mammography tube where characteristic radiation important

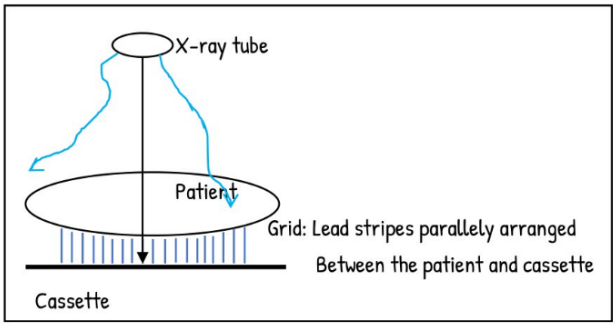
BREMSTRONG REACTION *05:31*

- e^- does not enter the nucleus
- Interaction with the +ve charge around the nucleus
- In this process it bends, deaccelerates and looses form of X-rays

- X-rays generated are mixed energy
- Filter is placed - they block low energy radiation
- Low energy radiations do not enter into patient

- Filter
  - ↓ses low energy radiation
  - ↓ses radiation dose to patient without affecting image quality
  - Made of aluminum - not lead (Blocks 100% energy)

- Collimator
  - Beam restricting device
  - Which restrict the path of -ray radiation beams and reduce scatter of radiation
  - Made of lead



- Grid :
  - Made up of lead
  - Between patient and film / cassette
  - It blocks the scatter radiation from reaching to film
  - Thereby improving image quality
  - Blocks all the scatter but also blocks some useful rays

- We have to slightly increase the radiation dose

- Cassette :
  - Imaged is formed
  - Film : single / double coated or emulsion films
  - Double coated / emulsion film
    - Less radiation film
    - Radiation required is less
    - Used in dental radiography, general purpose radiography
  - Screen : made up of Ca tungsten / rare earth metal
    - It converts X-ray into multiple light photon
    - It improves image quality
    - Majority of cassette used have double screen
    - In mammography - single screen cassettes

FILM FOCUS DISTANCE *12:23*

- Film focus distance (FFD) : from X-ray tube → cassette
- For all radiograph FFD = 100 cm
- Exception CXR, 180 cm
  - To reduce cardiac magnification

- CXR done at PA erect inspiratory view
  - Expiratory position → suspected pneumothorax
  - Supine position → when patient is not able to stand
  - AP view → Suspected rib fracture
  - Lateral decubitus view (I/L) → suspected minimum pleural effusion

- Lateral decubitus view → 10-15 ml
- CXR -PA → 150-200 ml

KVP & MAS *15:01*

KVP	MAS
• Kilo volt peak	• Milli ampere second
• Voltage supplied across the tube	• MAS = current x exposure time
• Voltage ∝ energy of beam	• No effect on energy

• KVP $\propto$ penetration • Contrast : difference b/w the color of ink in your image in comparison to background • $\uparrow$se KVP $\rightarrow \downarrow$se contrast or $\propto \frac{1}{contrast}$	• No effect • MAS $\propto$ no. of photons/unit area • MAS $\propto$ background blackening (film density) • MAS $\propto$ contrast

MCQ *17:15*

QUESTION : Contrast in a radiograph can be increased by _____?

A) $\uparrow$se KVP

B) $\uparrow$se MAS

C) $\downarrow$se MAS

D) $\downarrow$se exposure time

ANSWER : (B)

QUESTION : Which is the first factor that should be modified to image a heavily build patient?

A) $\uparrow$se KVP

B) $\downarrow$se KVP

C) $\uparrow$se MAS

D) $\downarrow$se MAS

ANSWER: (A)

QUESTION : Which factor should be modified to improve contrast in an obese patient?

A) $\uparrow$se KVP

B) $\downarrow$se KVP

C) $\uparrow$se MAS

D) $\downarrow$se MAS

ANSWER : (C)

Mammography

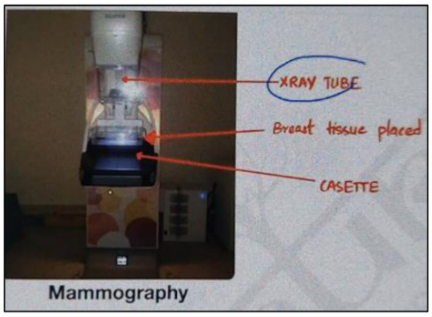
- Mammography → radiography of breast parenchyma
- Sonomammagrphy → USG of breast parenchyma
- MR → MR mammography
- CT - no rule

DIFFERENCES BETWEEN MAMMOGRAPHY &OTHER X-RAY TUBE

00:42

- Mammography
  - High contrast : ↓ KVP & ↑ MAS
    - Low energy, high amperage X-rays
  - Target made up of Molybdenum
  - Target window is made up of Beryllium
  - Filter - Molybdenum

- Most important reaction for X-ray production → characteristic radiation in mammography
- Amount of radiation : Mammography > CXR



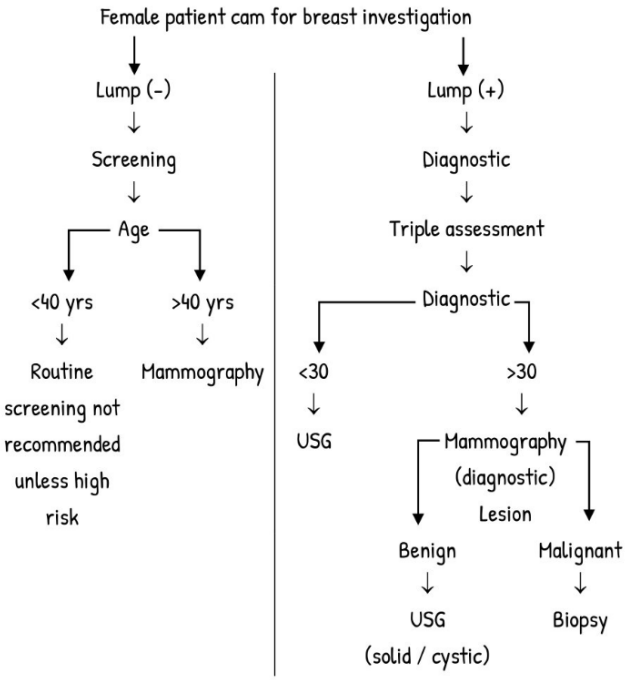
VIEWS IN MAMMOGRAPHY

02:21

- MLO view :
  - Medio lateral oblique view → more important
  - More amount of breast tissue covered in MLO view
  - Axillary tail is also covered

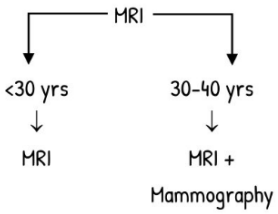
- Cranio caudal view : from head to toe

DECISION ON SPECIFIC INVESTIGATION 02:57



- **High risk** : >20% risk
  1) Genetic H/o : BRCA1, BRCA2, P53 mutation
  2) Family H/o : 1st degree relative breast Ca
  3) H/o therapeutic radiation to chest
     - Suffering from mediastinal lymphoma which was treated with radiation

- In <40 yrs - preferred screening is MRI
- Why mammography is not preferred in younger females?
  - Fibroglandular tissues is present in younger females
  - As age progresses, the glandular tissue ↓, fatty tissue ↑



SPECIAL SITUATIONS *06:41*

- Pregnancy → lump (+) → do USG irrespective of age
- Lactating female (mastitis / abscess) → USG
- Breast implant → MRI
- Prior surgery scar → MRI
- Best investigation → Biopsy

FEATURES OF BENIGN VS MALIGNANT LESION ON MAMMOGRAPHY *07:56*

BENIGN LESION	MALIGNANT LESION

• Well defined
• Round to oval
• Macrocalcification (large foci to calcification) → popcorn pattern
  ○ Mammography → fibroadenoma
  ○ CXR → pulmonary hematoma
  ○ MRI brain → cavernous angioma
  ○ Radiography of hand → enchondroma of hand
	• Irregular
	• Spiculated margins
	• Microcalcification (small, tiny calcification)

IRADS *09:32*

- Imaging Reporting and Data System : Standard nomenclature for radiological findings
- BIRADS : for breast $\xrightarrow{discovered\ on}$ Mammography $\xrightarrow{later}$ USG, MRI
- PIRADS : for prostrate → MRI
- CIRADS : for colon → virtual colonscopy (CT)
- LIRADS : for liver → MRI
- TIRADS : for thyroid → USG
- VIRADS : for urinary bladder → MRI

Mammography

Topic Notes: 4

- CORADS : for covid
- These do not determine the severity of the lesion

- BIRADS
  - 0 → incomplete evaluation → complete the evaluation
  - 1 → Normal mammography → continue routine screening
  - 2 → benign lesion → continue routine screening
  - 3 → probably benign (<2%) → short follow up [3-6 months]
  - 4 → suspicious → (>2%) → biopsy
  - 5 → highly suspicious → (>95%) → biopsy
  - 6 → biopsy proven cancer → to check C/L breast

Ultrasonography

ADVANTAGES OF USG *00:20*

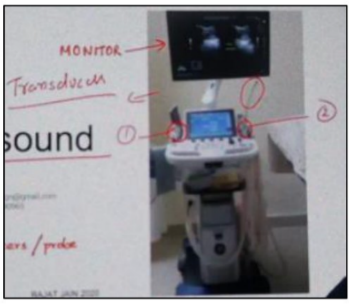
- No ionizing radiation
- Non invasive
- Cost effective
- Easily available

- Portable
  - Preferred in unstable patients - FAST / eFAST
  - Aortic dissection patient - unstable → TEG

- Realtime investigation

- Major limitation of USG → operator dependent

PARTS OF USG *01:43*



1 & 2 Transducer / probe

- Principle of USG : piezoelectric effect - generation of sound waves by passing electricity
  - Produced by crystals present inside the probe
  - Crystals are made up of PZT
    - Plumbum
    - Zirconium
    - Titanium
  - Quartz is no longer used

- Frequency vary from 2-20 MHz

- Curved Probe frequency - 2-7 MHz
- Flat probe frequency : 7-15 MHz
- Resolution $\propto \frac{1}{depth}$
- Thyroid USG → superficial body part $\xrightarrow{use}$ high frequency probe
- Liver USG → thick and deep part $\xrightarrow{use}$ low frequency probe

EUS 04:10

- Endoscopic ultrasound
- Done using an endoscope to reach the target tissue as close as possible
  - High frequency probe
  - Resolution is high

- Used for GIT
- Role of EUS
  - Intramural & extraluminal pathologies

- EUS is the most useful imaging investigation to see the layers of GIT
  - On EUS 5 layers of GIT are seen

- EUS is the most useful imaging investigations for local staging of GI imaging (T staging)
- For complete TNM staging → PET CT / CECT
- TEE - also a type of EUS
  - Also done to see the post chambers of the heart

- EUS is useful in locating the pathologies located in pancreas
- Most appropriate imaging investigation to confirm the diagnosis of carcinoma head of pancreas - EUS guided FNAC

WORKING OF USG 07:06

- Air is enemy of USG
- That is why we apply gel before performing USG
- Transducer → sends / receives signals → creates an image on monitor

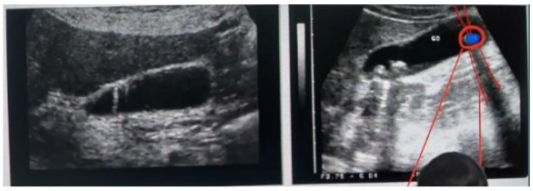
- Terminologies

Ultrasonography

Topic Notes: 7

	USG	CT	MRI
	ECHO	DENSE	INENSE
Hypo : anything black in radiology	Black		
Hyper : anything white in radiology	White		

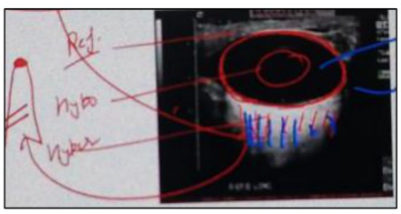
- Normal appearance of an undiseased tissue is reference
- Hyperechoic on USG
  - Fat
  - Air
  - Calculus, calcification and bone



Acoustic shadowing - hyperechoic

- Whenever a calculus comes in the path of USG beam, there is complete reflection of the beam and a shadow is seen posteriorly
  - Calculus
  - Ca^{2+}
  - Bone
  - Air

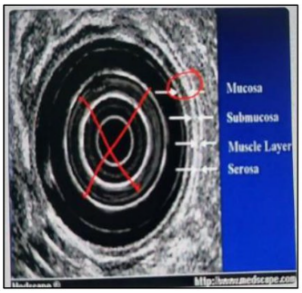
- Not seen in fat



Acoustic enhancement

- Differentiates solid lesion from a cystic lesion
- Very black lesion on USG → Anechoic (jet black) → clear fluid
- Lesion → acoustic enhancement
  - (+) → cystic
  - (-) → solid

- Terminologies in USG
  - Anechoic → clear fluid
    - Water
    - Bile
    - Non infected urine
    - Vitreous
  - Hypoechoic
  - Iso echoic
  - Hyperechoic



5 layers seen in endoscopic USG

1) White → mucosa
2) Black → deep mucosa - muscularis mucosa
3) White → submucosa
4) Black → muscle layer
5) Black → serosa

TYPES OF USG *14:43*

- Brightness → B mode
- Amplitude → A mode
  - Commonly done in ophthalmology for measurement of axial length of eyeball

- Motion → M mode
  - Valvular motion & morphology

- Doppler
  - Based on principle of doppler shift
  - When a structure is moving there is an apparent shift in the range of frequency

- Assess
  - Presence / absence of blood flow
  - Pick up the direction of flow
    - Blood towards the probe → red
    - Blood away from probe → blue
  - Velocity of the flow (vessel transducer angle <60°)
  - Pattern of flow
    - Arteries / veins (monophasic pattern without pulsation)
    - Arteries → peripheral (triphasic pattern) / visceral (monophasic pattern with pulsation)

DISEASES AND RADIOLOGICAL FINDINGS *18:39*

- Decrease in diastolic is the earliest sign of IUGR
- Absent diastolic flow → severe IUGR
- Reversal of diastolic flow → impending fetal death

ADVANTAGES IN RADIOGRAPHY *19:32*

- Elastography : picks up early cirrhosis
- Other roles : Characteristic of nodules in
  - Breast
  - Thyroid
  - Liver
  - Prostrate

- Malignant lesion → more hard → less elastic

- EFOV : extended field of view

- HIFU : high intensity focused USG
  - Therapeutic use - MRI guided HIFU
  - Standard technique to treat fibroids
  - Also used in low grade prostrate cancer
  - Localized RCC

USES OF USG

22:08

- Rules
  - Air & bones - enemy → not seen
  - Fluid - friend → seen

- Neonates :
  - Open anterior frontanalle (up to 18 months)
  - Diagnose hydrocephalus

- Face
  - Eyes → A & B scan
  - Salivary gland → parotids

- Neck
  - Thyroid
  - Neck vessels
  - LN

- Chest
  - ECHO → TTE & TEE
  - Endoscopic esophagus
  - Lungs → air cannot be seen
  - Pleura → can be seen

- Abdomen
  - Liver → first line investigation
  - GB → distended → fasting 4-6 hrs
  - CBD → USG not good investigation

- Pancreas
  - Retroperitoneal structure (below stomach)

- USG Not recommended

- Kidneys → CT done
- Ureters → totally retroperitoneal
  - CT done

Stones	Investigation
GB	USG
CBD	MRCP
Kidney / ureter	NCCT

- Most useful investigation in pregnancy → USG

- Scrotum → USG with or without doppler is Inx OC
- Intra abdominal testicular localization → MRI
- Gold standard → Laparoscopy

- **Lower limb** : preferred Inx. OC
  - DVT
  - Peripheral vascular disease
  - Varicose vein

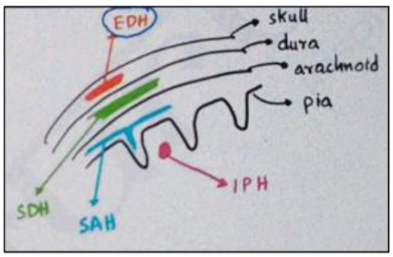
- Developmental displacement of femoral head
  - USG → screening
  - MRI → Inx. OC

- Fluid → most useful investigation is USG
  - Pericarditis
  - Pleural effusion
  - Ascites

Neuroradiology

HEAD TRAUMA

00:21



- EDH = Extradural hemorrhage
- SDH = Subdural hemorrhage
- SAH = Subarachnoid hemorrhage
- IPH = Intraparenchymal hemorrhage

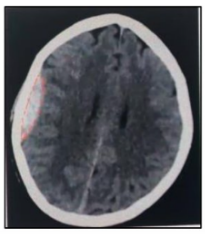
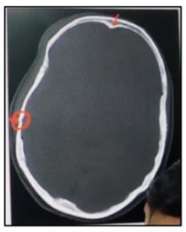
- EDH
  - Biconvex in shape
  - Because of attachment of dura at the suture
  - Cannot cross suture
  - MC vessel involved is middle meningeal artery

- SDH
  - Shape is crescent / concavo conves
  - Not limited by sutures
  - Bleeding is due to Bridging cortical veins

- SAH
  - No fixed shape
  - Blood in CSF (CSF present in subarachnoid space)

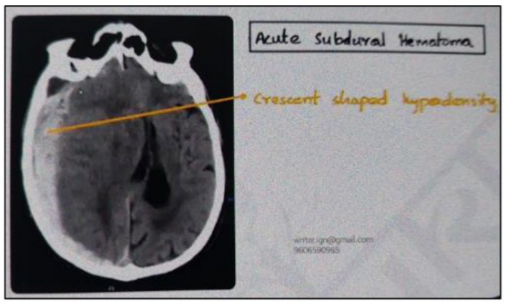
- Q → Blood present in CSF space :
  - Ventricle
  - Sulci
  - Fissure
  - Cistern

- On CT hematoma is divided into :
  - Acute → hyperdense
  - Subacute → isodense
  - Chronic → hypodense

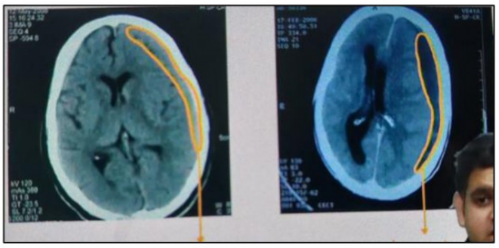
	
Brain window Lentiform shaped hyperdensity ↓ Acute extradural hematoma	Bone window Fracture of Right temporal bone

Swirl sign

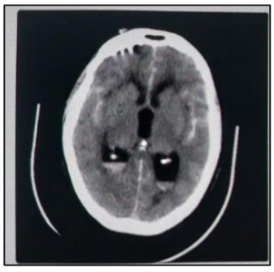
- Acute EDH
- Swirl sign
  - Areas of hypodense
  - Seen in EDH
  - Sign of active bleeding
  - Hematoma is expanding
  - Has to be taken out immediately



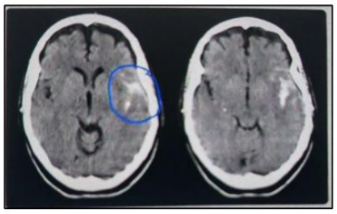
HEMATOMA



Subacute SDH Chronic SDH



Acute SDH



Acute SDH

- Blood in fissure

Intracerebral hematoma

- SAH
  - MCC of SAH is trauma
  - MCC of atraumatic SAH is rupture of Berry aneurysm

DAI

04:24

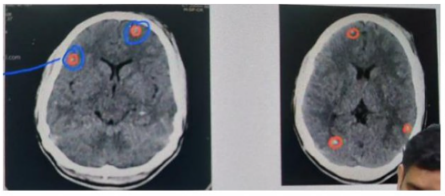
- Diffused axonal injury
- Shearing type of injury exerted on the axons resulting in breakdown of axonodendritic connection

  ↓

  Patient is unconscious

- Triad : RTA + unconscious patient + normal NCCT
- In 80% patient NCCT is normal
- Investigation of choice - MRI
- Characteristic location of punctate hemorrhage in NCCT of DAI
  1) Grey white matter junction
  2) Corpus callosum
  3) Brain stem (dorso lateral)

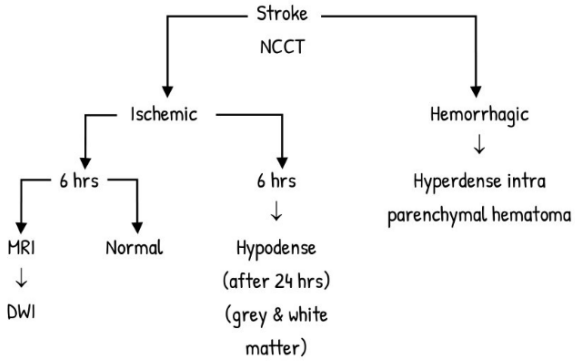
CT findings in DAI



- Areas of tiny hemorrhages at the grey white matter junction

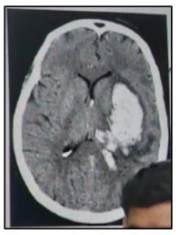
STROKE 06:34

- Stroke : sudden focal or global loss of neurological function which is vascular in nature and last for more than 24 hrs
- <24 hrs - transient ischemic attack

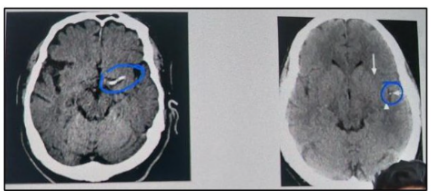


- Rx of choice in ischemic → thrombolysis, <4.5 hrs
- Thrombolysis C/I in hemorrhagic

Ischemic stroke (DWI)



Hemorrhagic stroke

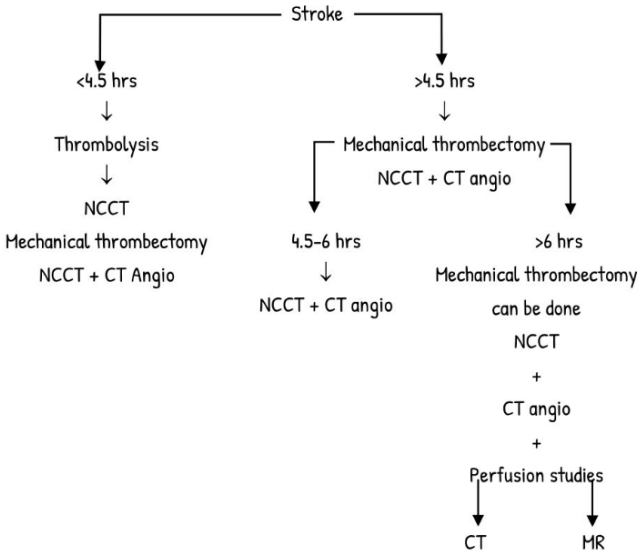


Thrombus within artery - Hyperdense MCA sign

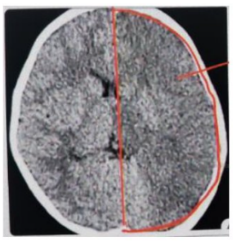
Sylvian Dot sign

MECHANICAL THROMBECTOMY

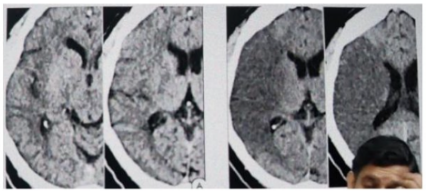
- Done up to 24 hrs



- 4 Ps pf stroke imaging
  1) Parenchyma → NCCT → hemorrhage
  2) Pipe → CT angio → large vessel occlusion
  3) Penumbra } CT
  4) Perfusion } perfusion



Classical early ischemia
Will take >6 hrs

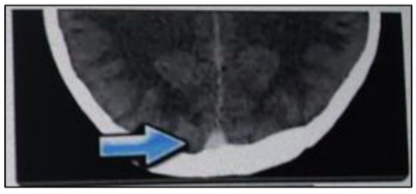


<24 hrs >24 hrs

PERFUSION CT

- CBV
- CBF
- MTT
- Cerebral blood flow is reduced in both ischemic penumbra and infracted core
- CBV is reduced in flow, increased in ischemic penumbra
- MTT is increased in both

3 parameter	Infract core	Ischemic penumbra
CBF	↓↓↓↓	↓↓↓
CBV	↓↓↓	(N) / ↑
MTT = $\frac{CBV}{CBF}$	↑↑↑	↑↑↑



Delta sign

Calcifications

CALCIFICATION IN BRAIN

15:49

- Normal physiology sides of calcification
  1) Pineal gland (MC)
  2) Choroid plexus
  3) Interhemispheric falx
  4) Ant. & post. clinoid ligament
  5) Habenular
  6) Basal ganglia (5%)

- Pathological patterns of calcification
  1) Periventricular pattern → CMV
  2) Diffuse nodular pattern → toxoplasmosis
  3) Bracket pattern → corpus callosal lipoma
  4) Calcified subependymal nodule → tuberous sclerosis (candle dripping appearance)
  5) Starry sky pattern → neurocisticercosis
  6) Gyral pattern → Sturge weber syndrome (tram track pattern)

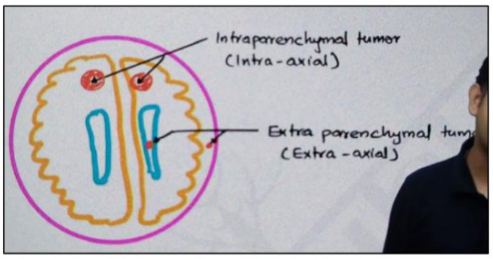
- Starry sky
  - NCCT brain : NCC
  - Pathology : Burkitt's lymphoma
  - USG abdomen : acute viral hepatitis

- Tram track
  - Brain : SWS → NCCT
  - Ophthal : CRAO → retinoscopy
  - Orbit : optic nerve sheath meningitis → MRI

- Chest : bronchiectasis → HRCT
- Micro : Hemophilus ducrei → microbiological exam
- Kidney : membranous proliferative glomerulo nephritis → micro
- Spine : ankylosing spondylosis → X-ray
- Forensic medicine : patterned abrasion → forensic finding

BRAIN TUMORS

18:12



- MC overall brain tumor → metastasis / 2°
- MC 1° brain tumor → meningioma
- MC 1° intra parenchymal tumor → glioma, astrocytoma
- MC brain tumor to show Ca^{2+} → craniopharyngioma
- MC intraparenchymal brain tumor to show Ca^{2+} → oligodendroglioma
- MC B.T in pineal gland → germinoma
- MC B.T to show necrosis → GBM
- MC B.T to cross midline → GBM

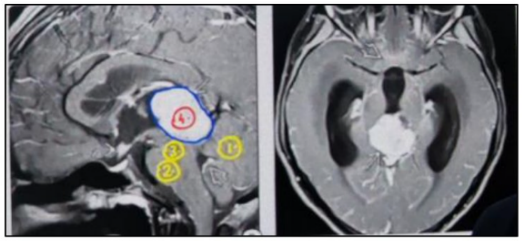
TUMORS ASSOCIATED WITH SYNDROMES

1) Neurofibromatosis I
   - Optic nerve glioma
   - Meningioma

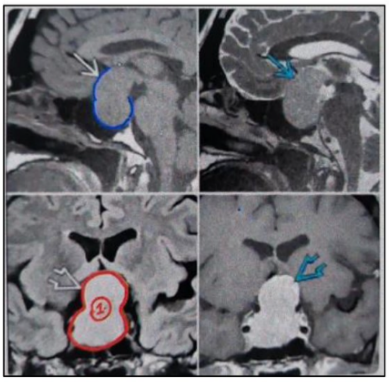
2) Neurofibromatosis I
   - Vestibular schwannoma
   - Cerebello-pontine angle cistern

3) Tuberous sclerosis
   - SEGA

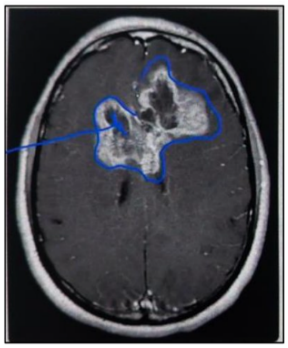
4) VHL - cerebellar hemangioma
(Von Hipple Lidau syndrome)



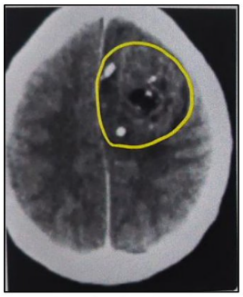
Classical appearance of germinoma



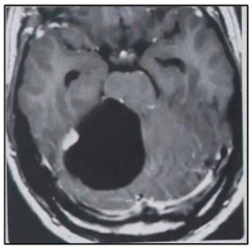
Pituitary macroadenoma



GBM → crosses midline



Oligodendroglioma

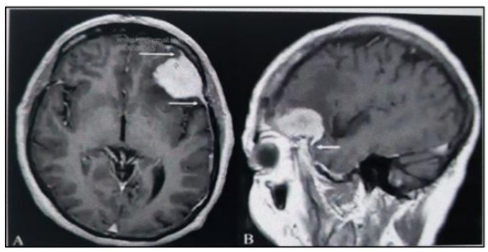


Cerebellar hemangioma

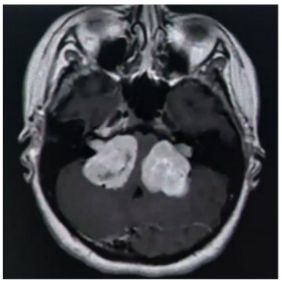
MENINGIOMA

22:45

- Commonly seen in 30-50 yrs of age
- Females are commonly affected
- MC symptom headache
- CT → hyperosteosis
- MRI → Dural tail sign
- Angiography → mother in law sign



Meningioma → Dural tail sign



B/L Vestibular schwannoma

EPILEPSY *24:31*

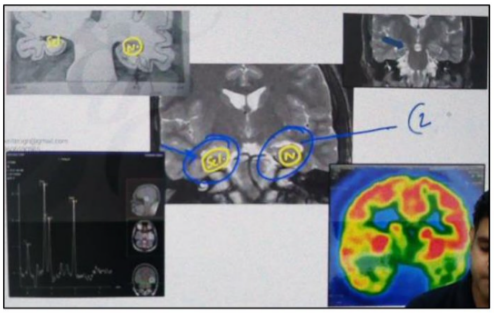
- 1° GTCS - no much role of imaging
- Imaging has much role in complex partial seizures
- Intractable epilepsy → Hippocampal sclerosis / mesial temporal sclerosis
- MCC of surgical treatable epilepsy

- Hippocampus
  - Present at the medial part of temporal lobe
  - Most sensitive part of brain to hypoxia
  - MCC of surgically treatable epilepsy

- Investigation of choice to diagnose this → MRI epilepsy protocol
  - Oblique coronal T2W MRI taken

- Findings
  1) Hippocampal atrophy
  2) Increase signal on T2W
  3) Atrophy of fornix
  4) Atrophy of mamillary body
  5) Advance cases : atrophy of I/L temporal lobe

- Functional images to diagnose hippocampal sclerosis
  1) Interictal PET → reduced metabolism
     - Best investigation to know etiology of intractable epilepsy
     - Video EEG with ictal HMPAO SPECT



BRAIN INFECTIONS *27:01*

- Meninges → meningitis
  - Fever
  - Neck rigidity
  - Diagnosis : CSF exam by lumbar puncture
  - CE MRI brain → leptomeningeal enhancement

- Parenchyma → encephalitis
  - Fever
  - Convulsions / Altered sensorium

- SAH
  - No fever
  - Neck rigidity

- Focal lesion
  - No fever
  - Convulsion / altered sensorium

- Tubercular meningitis
  - Basal meningitis triad :
    1) Enhancing basal exudates
    2) Hydrocephalus
    3) Vascular infract

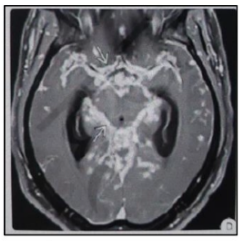
  - Cryptococcal meningitis → basal meningitis
  - Immunocompromised patient / AIDS

- MRI → prominent Virchow Robbin spaces
- CSF microscopy → India ink staining
- Soap bubble appearance
  - MRI brain → cryptococcoma
  - Radiograph → giant cell tumor

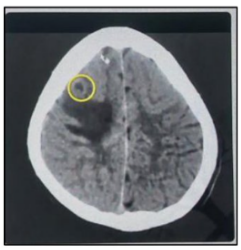
- Encephalitis
  - Frontal & temporal → HSV 1
  - B/L thalamus & brainstem involved → JE

- HIV : neurotrophic virus

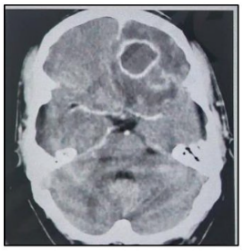
HIV encephalopathy	Progressive multifocal leukoencephalopathy
• Causative org = HIV • MC C/f : ⇒ Forgetfulness ⇒ Cognitive impairment ⇒ Dementia (ADC) • MRI : symmetric deep white matter involvement	• JC virus • Focal deficit • Monoparesis • Asymmetric subcortical white matter involvement



Tubercular meningitis



Neurocysticerosis



Necrotic lesion

NAMED SIGNS *32:03*

- On radiograph - shape of skull
  1) Hair on end appearance → thalassemia
  2) Punched out lytic lesion → multiple myeloma
  3) Geographic lytic lesion → eosinophilic granuloma
  4) Cotton wool skull → Paget's disease
  5) Salt and pepper → hyperparathyroidism
  6) Silver / copper beaten → raised CT

- Earliest radiographic sign of raised ICT
  - In children → sutural separation
  - Adult / older child → erosion of dorsum sella

- Orbit
  - Empty orbit sign → neurofibromatosis 1
  - Tear drop sign → blow out fracture

- MRI sign
  1) Eye of tiger
  2) Tigroid pattern
  3) Face of panda
  4) Face of panda on gallium scan
  5) Humming bird
  6) Molar tooth
     Bat wing
  7) Hot cross bunn sign
  8) Mount fuji sign

Thoracic and Cardiovascular Radiology

CHEST XRAY 00:21

- CXR
  - PA
  - Inspiratory
  - Erect view

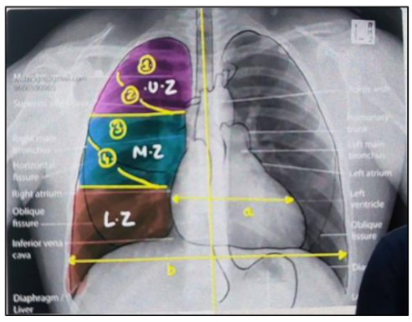
- Erect view → fundic bubble

	PA	AP
Clavicle	Oblique	Horizontal
Scapula	Outside the lung field	Overlap the lung field
Ribs	Oblique	Horizontal

- Inspiratory & expiratory view can be assessed by diaphragm
- Mid clavicular line
  - Anterior end of >5th rib crossing the diaphragm → inspiratory failure

- Bone density → very white → cortical bone / calculus / Ca^{2+}
- Soft tissue density → everything else
- Air density → very black → only air

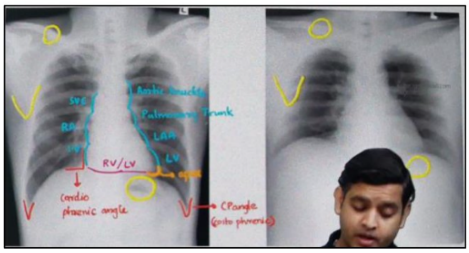
ASSESS CARDIOMEGALY ON CHEST XRAY 02:11



- Assess always in PA view and not rotated

- Heart size :
  - Midline is drawn
  - Maximum cardiac diameter of Rt. & Lt are added

- Line drawn from inner thoracic margin
  - $\frac{a}{b}$ x 100 is calculated
  - <50% = normal
  - >50% → cardiomegaly



PA view, inspiratory erect AP supine view

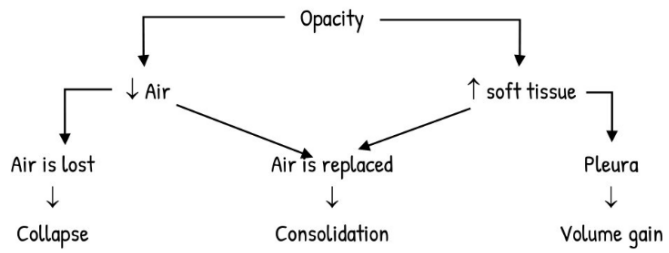
- Rt heart border
  - SVC
  - RA
  - IVC

- Lt heart border
  - Aortic knuckles
  - Pulmonary trunk
  - LAA
  - LV

- Apex - LVH in majority of cases
- In diseased cases (like tetralogy) - formed by RVH
- Inferior border - RV & LV

TERMINOLOGIES USED IN CHEST XRAY 05:02

- Lucent → black
- Opaque → white

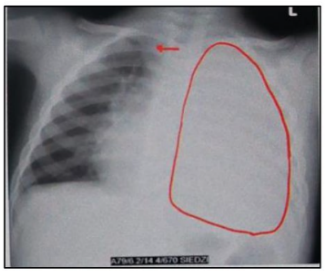


Collapse	Consolidation
• Loss of air • Crowding of ribs • Elevation of hemidiaphragm • I/L mediastinal shift • Sharp margins • Displacement of interlobar fissure is the most reliable direct sign of collapse	• Replacement of air • X • X • X • Indefined margins • Air bronchogram sign → alveolar opacity Visualization of air in bronchi surrounded by alveolar opacity Examples: • Exudates - pulmonary (alveolar) ○ Not interstitial pneumonia - mycoplasma, viral • Fluid ○ Pulmonary edema ○ ARDS ○ Hyaline membrane disease • Blood ○ Alveolar hemorrhage ○ Good pasture syndrome

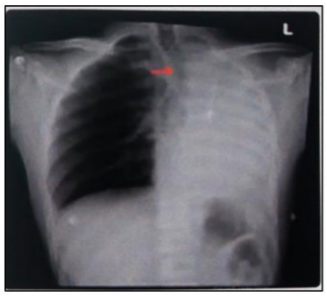
- Ground glass appearance - haziness of lung field, without obscuration of blood vessels
- Consolidation - opacity with obscuration of blood vessels

- Both are seen in covid
  - Early - ground glass (peripheral areas - CT scan)
  - Advanced - consolidation

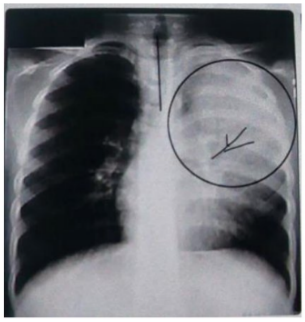
- Volume gain features
  - Widening of I/L space
  - Depression of diaphragm
  - C/L mediastinal shift



Massive pleural effusion



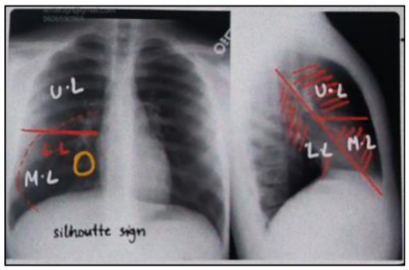
Collapse



Consolidation

Collapse

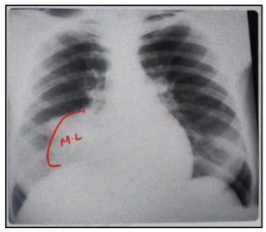
- Reverse "S" sign / Golden "S" sing
- Right upper lobe collapse secondary to a bronchogenic cancer



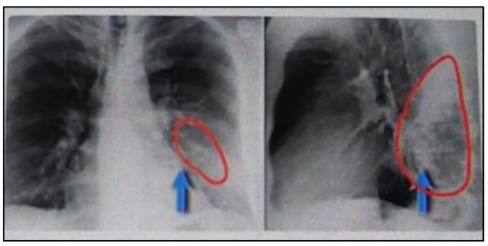
Silhoutte sign

- If 2 structures of same density are in anatomical continuity with each other, their interface is lost, however they overlapping their interface is seen

Silhouette structure	Contact with lung
Upper right border / ascending aorta	Anterior segment of RUL
Right heart border	RML (medial)
Upper left heart border	Anterior segment of LUL
Left heart border	Lingula (anterior)
Aortic knob	Apical portion of LUL (posterior)
Anterior hemidiaphragms	Lower lobes (anterior)



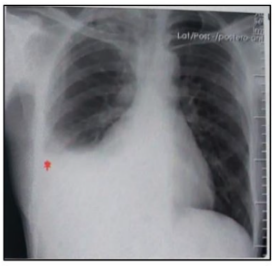
Opacity lies in anterior aspect → middle lobe



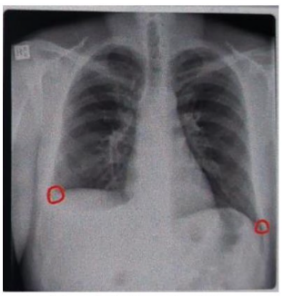
Opacity lie posteriorly

DISEASES ON CHEST XRAY

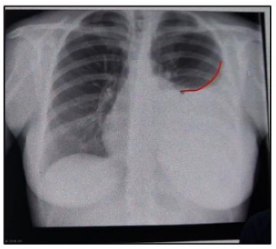
13:57



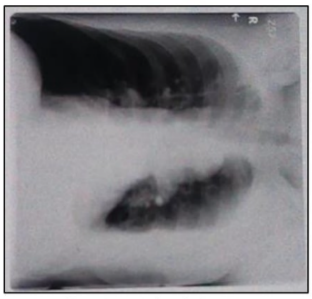
- Blunting of CP angle
- At least 150-200 ml of pleural effusion



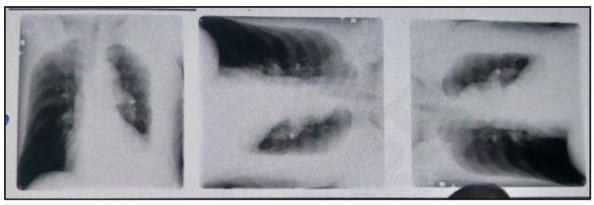
Right sided pleural effusion



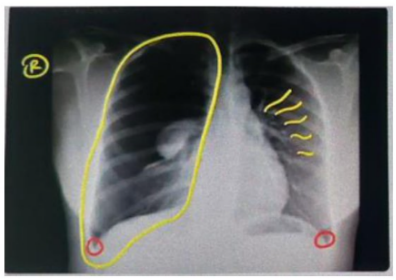
Marked left sided pleural effusion



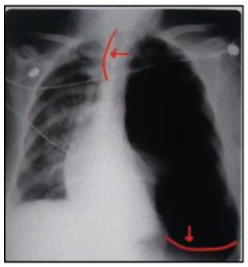
Left Lateral decubitus view
10-15 ml of fluid can be seen



Left pleural effusion → Left Lateral decubitus view



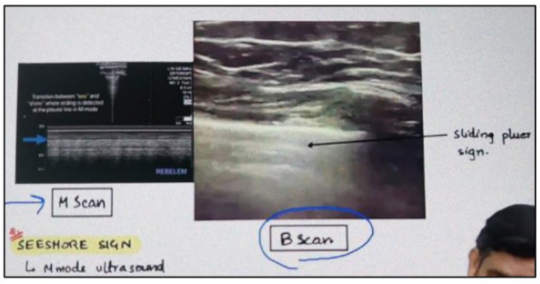
- Area of hyperlucency along the lateral aspect devoid of any vascular marking
- Pneumothorax → right sided



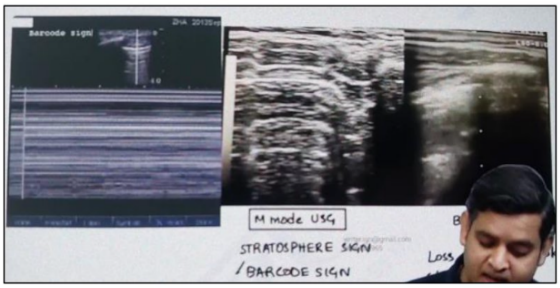
Tension pneumothorax

- Traches shifted opposite side
- Diaphragm shifted down
- Air under pressure

- Supine Xray
- All air collected anteriorly → CP angle
- Deep sulcus sign → sign of pneumothorax in supine view
- Best xray to diagnose pneumothorax → chest x-ray PA, in expiration



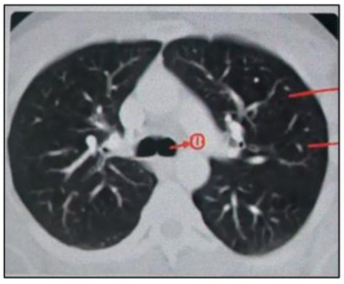
- Both are normal



- Seen in pneumothorax of M mode USG

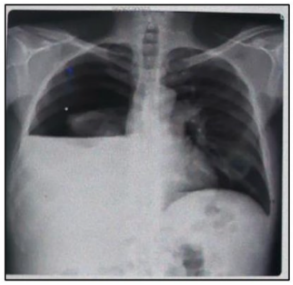
CT SCAN CHEST

19:10

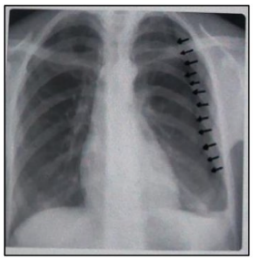


Normal lung CT

Right sided pneumothorax



Hydropneumothorax



Left sided pneumothorax

MEDIASTINAL LESIONS

20:15

- Draw a line from the anterior tracheal margin to the posterior pericardium
- Draw 2nd line 1cm behind the anterior vertebral

- Divides in three spaces :
  1) Anterior
  2) Middle
  3) Posterior

- Anterior mediastinal mass : 4 Ts
  - Thymoma
  - Teratoma
  - Thyroid masses
  - Terrible lymphoma

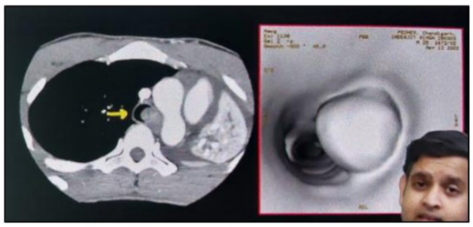
- Middle mediastinal mass :
  - LN
  - Vascular
  - Pleuro pericardial cyst

- Posterior : neurogenic

- In anatomy → heart is a part of middle mediastinum
- In radiology → heart is a part of anterior mediastinum

- Investigation of choice for mediastinal mass → CECT
- Investigation of choice for mediastinal mass → MRI (because they are neurogenic in nature

VIRTUAL BRONCHOSCOPY *22:35*



- Non-invasive kind of bronchoscopy
- Distal part of trachea
- Limitation : Biopsy cannot be taken

PULMONARY INFECTIONS *23:23*

TB
↓
Chest Xray

- 1° → latent infection
  - Ghon's complex
    - Hilar lymphadenopathy → mediastinal enlargement
    - Lymphatics
    - Subpleural focus

- Post 1° → reactivation
  - Cavitation
  - Fibrosis → septal thickening
  - Apical predominance

- Hematogenous
  - Miliary nodules <5 mm
  - 1° / post 1° both
  - Causes of military nodules
    - TB
    - Fungal infection
      - Histoplasmosis / coccidioidomycosis
      - Silicosis
      - Sarcoidosis

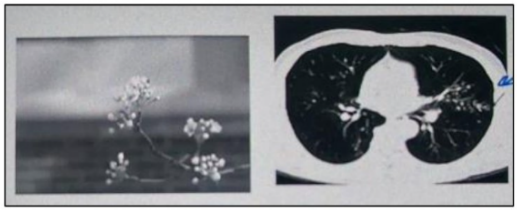
- Metastasis : kidney, thyroid, melanoma
- Hemosiderosis → M.S

- Endobronchial route
  - Linear branching nodules → tree in budd sign
  - Also seen in RSV pneumonia

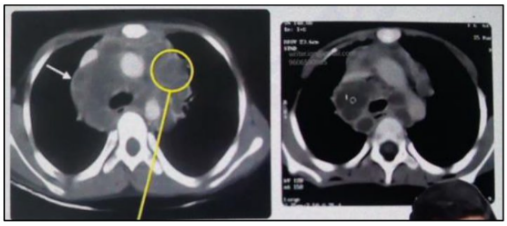
- Complications in TB

1) Cavitation
   - Air fluid level → abscess formation
   - Fungal growth → air crescent sign
   - Cavity can lead to hemorrhage - present as hemoptysis
   - MC vessel involved in TB - bronchial artery
   - Rasmussen's aneurysms
     - From pulmonary artery
     - Involved in TB
     - Rare aneurysm
     - Life threatening hemoptysis

2) Fibrosis → Bronchiectasis → MCC : TB
   - Investigation of choice : HRCT
   - Signs :
     - Tram track
     - Signet ring
     - Cluster of grape appearance



Tree in bud pattern → endobronchial TB

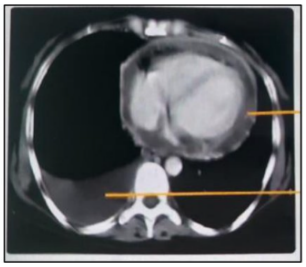


Typical necrotic enlarge mediastinal LN

- Cavities
- Consolidation
- Tree in bud pattern

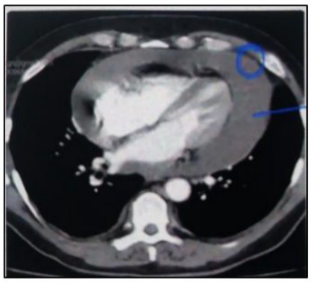
} Diagnostic for TB

Abscess : air fluid level within lung parenchyma

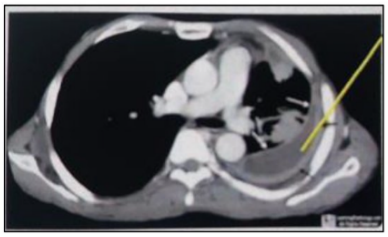


Pericarditis

- Pericardial effusion
- Pleural effusion



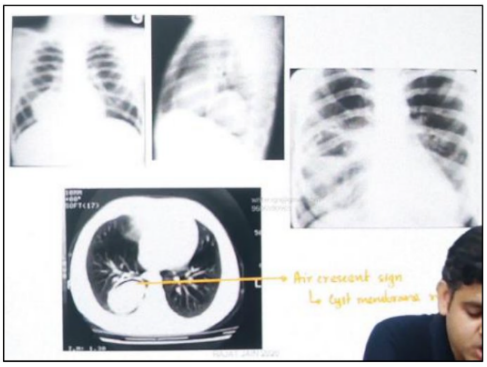
Pericardial effusion



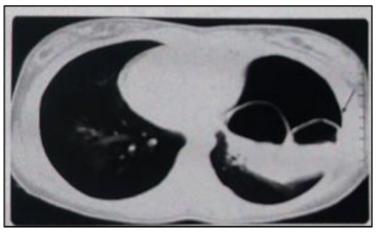
Emphyma - Split pleural sign

HYATID CYST

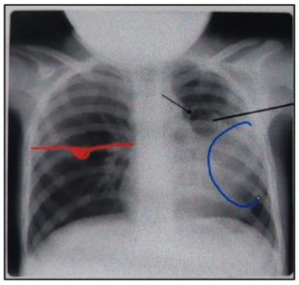
30:14



- Air crescent sign
- Cyst membrane rupture

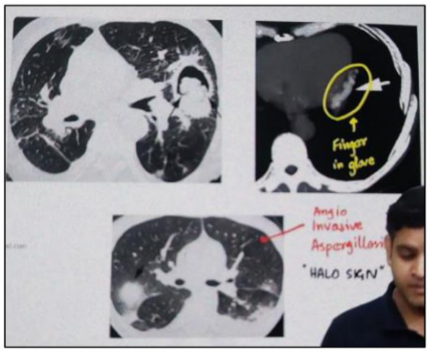


Floating water lilly sign



Pneumatocoel formation → staphylococcal pneumonia S. aureus

- Klebsiella pneumonia → bulging fissure sign



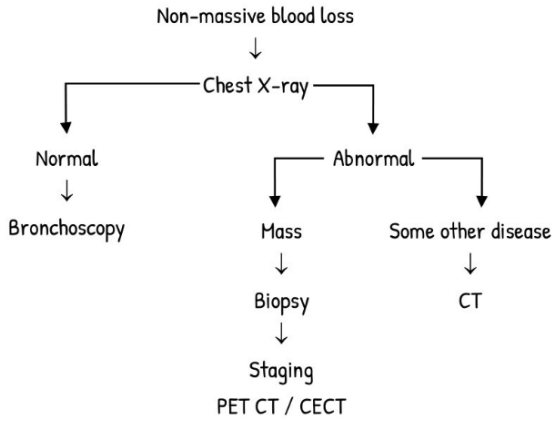
Aspergilloma

- ABPA - Allergic Bronchopulmonary aspergillosis
- Allergic to aspergillus protein
- Characterized by thickened & dilated bronchi filled with high density mucus → finger in glove appearance
- ABPA presents with central bronchiectasis (also cystic fibrosis)

HEMOPTYSIS

33:27

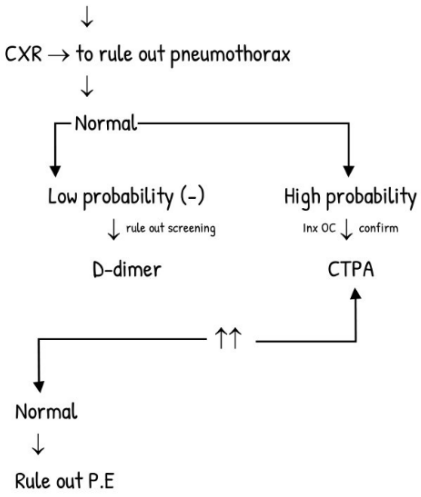
- Check pulse / BP
  - ↓ ↓
  - Thready Low
  - Massive blood loss
  - ↓
  - Stop the bleeding
  - ↓
  - MC vessel involved bronchial artery
  - ↓
  - Bronchial artery embolization
  - ↓
  - Polyvinyl alcohol particals (PVA)



- MRI → Pancoast tumor
- CECT → adrenal gland should always be included in the imaging because it is the MC site of metastasis from Ca lung

SUDDEN ONSET DYSPNEA

35:12



- Named signs on CXR
  1) Westermark sign → focal oligemia
  2) Palla's sign
  3) Hampton's sign

PULMONARY EDEMA

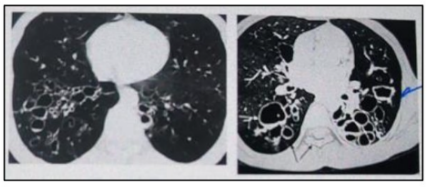
36:21

- Severe manifestation of PVH → ↑ PCWP
- Normal = 9-12 mm Hg
- CXR
  - 12-20 mm Hg → Gd I PVH
    - Upper lobe diversion of blood
    - Cephalization of blood vessels
    - Reverse mustache sign
    - Antler sign

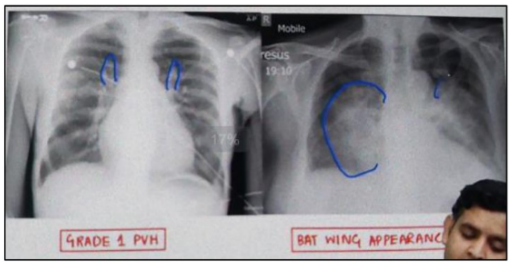
    (Earliest sign)

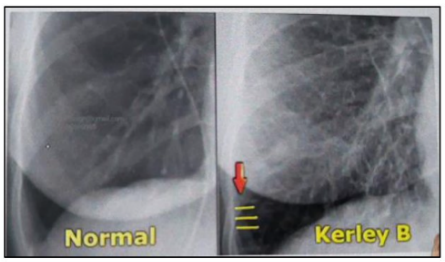
- PCWP = 20-25 mm Hg → Gd II PVH
  - Interstitial edema
  - Thickened lymphatics at base of lungs → Kerly B lines

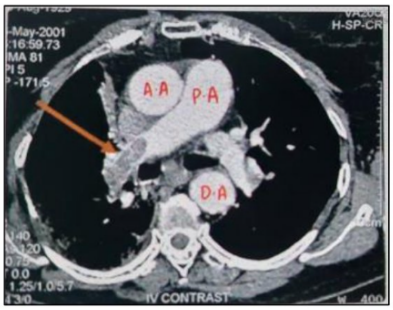
- PCWP >25 mm Hg → alveolar edema
  - Bat wing appearance



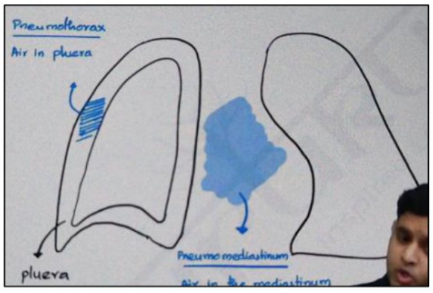
Cystic Bronchiectasis







Filing defect within pulmonary artery - pulmonary embolism



- Air in the mediastinum
- MCC → rupture of emphysematous bullae
- Best imaging investigation : CT

- **On radiography :**
  1) Air encircle thymus → Spinnaker sail sign
  2) Pulmonary artery → ring around artery sign
  3) V sign of neclario
  4) Continuous diaphragm sign

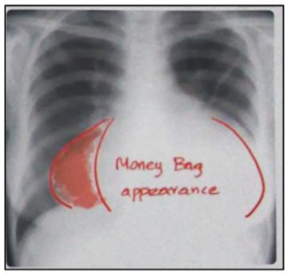
- Continuous diaphragm sign also seen in pneumopericardium

PULMONARY ALVEOLAR PROTEINOSIS *39:42*

Crazy paving pattern

- May be seen in very extensive covid-19 cases

Classical - metastasis



Money bag appearance

NAMED SIGNS *41:07*

- Figure of 8 → Supra cardiac TAPV (total anomalous pulmonary venous connection)
- Box shaped heart → Ebstein anomaly
- Boot shaped heart → TOF
- Egg on string → TGV
- Sitting duck heart → persistent truncus arteriosus
- Egg in a cup → constrictive pericarditis
- Jug handle → primary pulmonary hypotension

CARDIAC IMAGING *41:45*

- Coronary angio
  - Blood to heart is via coronaries → best way → catheter angiography
  - Radial route

- CT angio
  - Dual source CT
  - Mid diastolic phase

- NCCT
  - Calcium in coronary vessel
  - Coronary calcium score
  - AGATSTON SCORE

- Ventricular function
  - Most practical test to see this is ECHO (not accurate test)
  - Accurate → MUGA
  - Most accurate → cardiac MRI

- RWMA : non functioning myocardium
  - Dead → non viable
  - Unconscious → hibernating myocardium → viable

- Viablity test
  - Thallium test
  - Sesta MIBI
  - MRI
  - FDG PET (best)

- Left atrial enlargement signs
  - Enlargement of the LA appendage
  - Splaying of the carina
  - Elevation of the LMB
  - Double density projecting over the central portion of the heart
  - Displacement of descending aorta to the left (Bedford sign)
  - Always check left heart border for straightening

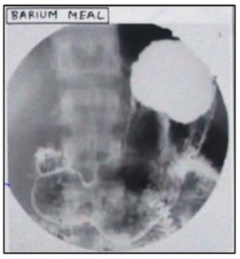
- Earliest sign - barium swallow, indentation of esophagus
- Posterior displacement of esophagus / indentation of the anterior wall of the esophagus

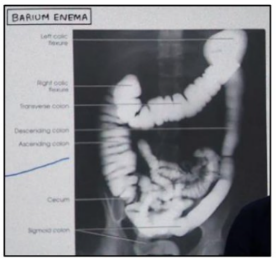
Abdominal Radiology

BARIUM SULFATE CONTRAST RADIOLOGY

00:21

- Esophagus → barium swallow
- Stomach & duodenum → barium meal
- Small intestine → barium follow-through
- Large intestine → barium enema





- Barium enteroclysis
  - Disadvantage : incomplete distension
  - Ba MFT
    ↓
    Bilbao Dotter tube : nasojejunal catheter
    ↓
    DJ junction
    ↓
    Inject dye with pressure

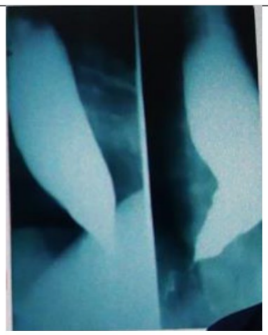
- CT enteroclysis
- Advantage : intra & extra luminal pathology
- Replaced by CT enterography
  - Investigation of choice for small bowel pathologies

- Patient asked to drink mannitol

Achalasia

There is smooth, tapered narrowing of the distal esophagus, producing a beak-like appearance at the gastroesophageal junction. This break like deformity occurs in the region of the lower esophageal sphincter, which relaxes intermittently, allowing small spurts of barium to enter the stomach. These findings are characteristic of primary achalasia

BIRD BEAK APPEARANCE



Achalasia – bird beak appearance

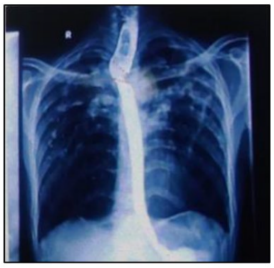
Rat tail appearance

Diffuse esophageal spasm - cork screw apprance

CA esophagus - apple core appearance

Hiatal hernia

Diverticulosis - saw toothed appearance



Dysphagia lusoria - abberent right subclavian artery

Sigmoid volvulus

PROTOCOLS FOR ABDOMINAL TRAUMA

03:59

Abdominal trauma
↓
Hemodynamic stability
- Stable → Clinical examination
  - I/P injury → CECT
  - +/- → FAST
    - (+) → CECT
    - (-) → observe the patient
- Unstable → Exploratory laparotomy
  - **USG** : to check abdomen have blood or not (FAST)

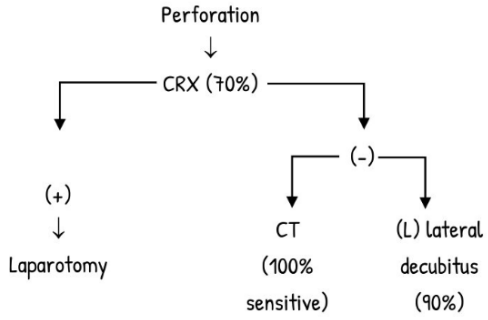
- FAST : Focused Assessment by Sonography in Trauma

- **Aim** : to assess fluid collection
  1) Right upper quadrant - perihepatic & Rt. Subhepatic space
  2) Subxiphoid - pericardial fluid
  3) Left upper quadrant - perisplenic
  4) Suprapubic - pelvic

- 1st site of assessment is morissons pouch
  - RUQ
  - Most dependent area

- FAST is replaced by eFAST
  - Extended : apart from abdomen + chest also included

PROTOCOL FOR PERFORATION *05:49*



- X-ray abdomen : erect, supine
  - Riglers sign
  - Foot ball sign
  - Cupo;a sign
  - Triangular tail sign

- Diagnostic peritoneal lavage - no longer recommended

PROTOCOL FOR INTESTINAL OBSTRUCTION *06:51*

- Intestinal obstruction → X-ray abdomen - erect & supine
- Investigation of choice → CECT

INVESTIGATION AND DISEASES – ORGAN WISE

07:18

- Liver
  - 1st investigation : USG
    - Solid → triphasic scan (MRI > CT)
    - Cystic lesion → clear / turbid

- GB
  - USG is preferred
  - Acute cholecystitis : walls of gall bladder thickens and edematous
  - Chronic cholecystitis : GB is contracted with multiple stone
    - Wall, echo, shadow (WES) sign seen in USG
  - Gall stones 90% are radioluscent
  - Radiography (old) → gall trap air - Mercedes benz sign

- CBD
  - Investigation of choice → MRCP

- Pancreas

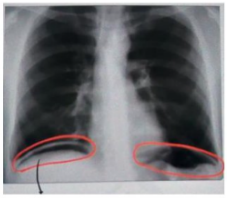
<table>
<tr><th>Acute pancreatitis</th><th colspan="2">Chronic pancreatitis</th></tr>
<tr><td>Inx OC - biochemical test</td><td colspan="2">Permanent structural changes in duct / parenchyma</td></tr>
<tr><td>Inx OC to asses severity of acute pancreatitis - CECT
○ Degree of inflammation
○ Necrosis of pancreas</td><td>Duct</td><td>Parenchyma</td></tr>
<tr><td>Balthazar → tells about inflammation only
It is replaced by ↓</td><td rowspan="2">Irregular dilated beaded pancreatic duct
"chain of lake"
Inx
↓
EUS
↓
MRCP
↓
ERCP</td><td rowspan="2">Atrophy with or without calcification
↓
CT</td></tr>
<tr><td>CT severity score → both inflammation & necrosis assessed</td></tr>
</table>

Diaphragmatic hernia

Intestinal obstruction - string of bead appearance

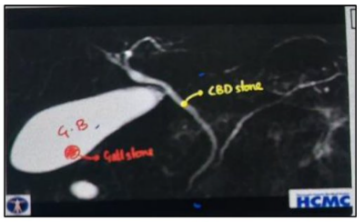
- String of bead
  1) X-ray abdomen → intestinal obstruction
  2) ERCP → chronic pancreatitis
  3) Angiography → fibromuscular dysplasia

Duodenal atresia - double bubble appearance



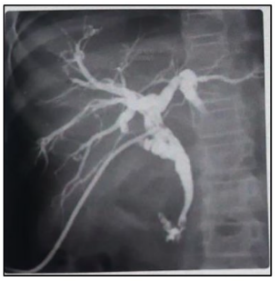
Air under right dome of diaphragm

3D CT



MRCP → T2W MRI

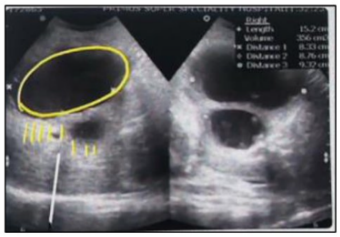
ERCP → endoscope can be seen



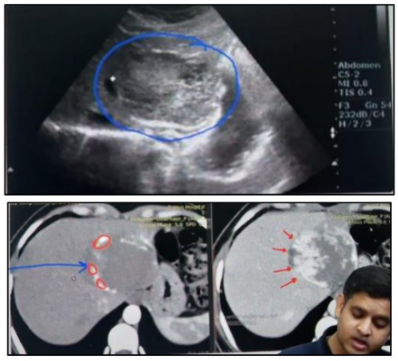
T-Tube cholangiography

Acute calculus cholecystitis

Hydatid cyst - cart wheel appearance

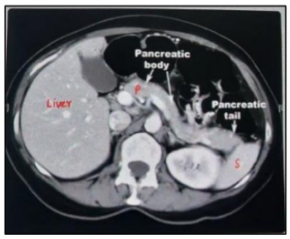


Liver abscess - turbid fluid containing lesion in liver

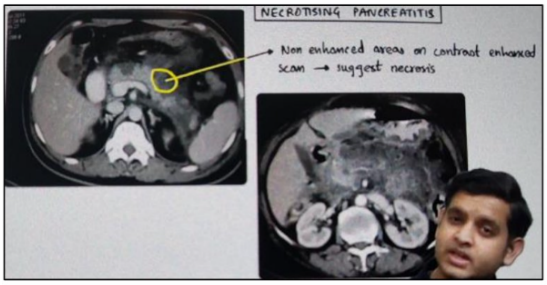


Hepatic hemangioma

Hepato cellular carcinoma

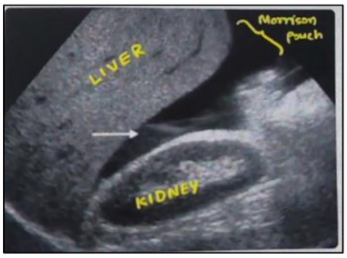


Normal CECT

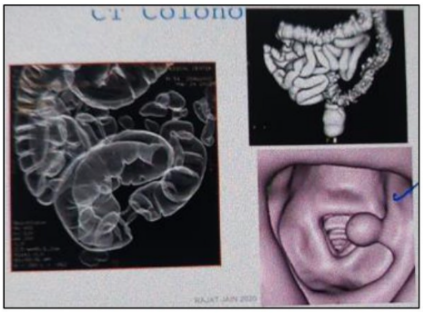


Necrotizing pancreatitis

FAST *15:13*



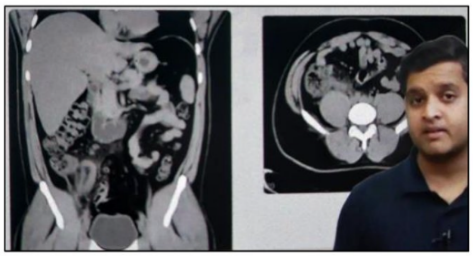
FAST +ve → RUQ : blood in morrison pouch



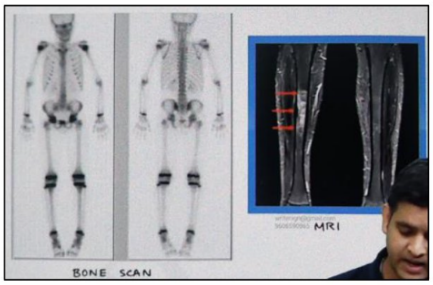
Virtual colonoscopy

ACUTE APPENDICITIS *15:57*

- Predominantly clinical diagnosis
  - Children → USG
    - Blind ending
    - Tubular aparistaltic structure with outer wall to wall diameter >7mm
  - Adults → CT
    - Blind ending
    - Tubular structure
    - Diameter >6 mm
    - Periappendiceal fatty streakiness



Musculoskeletal Radiology



Bone scan & MRI

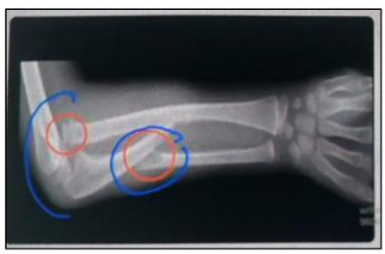
- Cortical bone
  - Radiography - simple anatomy
  - CT scan - CT scan

- Cancellous bone / BM :
  - MRI - localized
  - Bone scan - generalized / non-localized

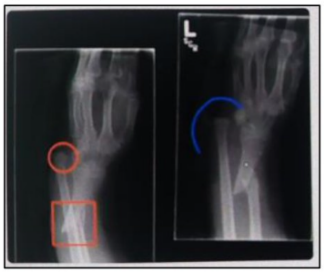
- Bone mineral density → DEXA
- Soft tissue : MRI
  - Ligament
  - Tendon

NAMED FRACTURES *01:29*

- Montaggia fracture
  - Ulnar fracture
  - Displacement of proximal radio-ulnar joint



- Galezzi
  - Fracture of radius
  - Distal radio-ulnar joint disrupted



- Colle's fracture
  - Fracture at distal end of radius
  - Dinner fork deformity

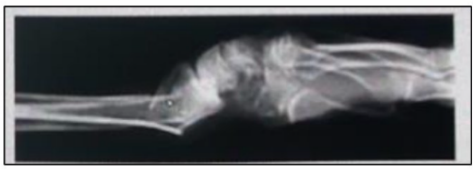


Fig. (11a). Colles' fracture showing dinner fork deformity

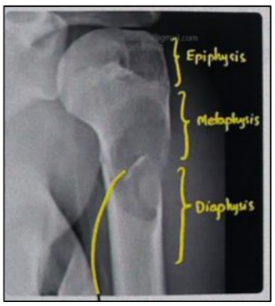
- March fracture
  - Subtle fracture at the shaft of meta tarsal (2nd or 3rd)

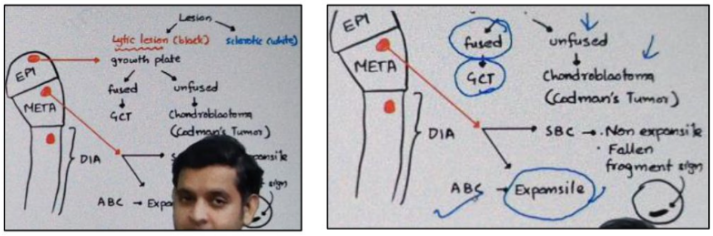
a) Bullet shape vertebrae → acondroplasia
b) Cord fish / fish mouth → severe osteoporosis
c) H shape vertebrae → sickle cell anemia
d) Sandwich appearance → Rugger jersey spine → Fenal osteodystrophy / osteopetrosis

e) Coudray appearance → vertebral hemangioma
f) Vertebra plana [MELT]
   i. Eosinophilic lymphoma
   ii. Myeloma / metastasis
   iii. Lymphoma
   iv. Trauma
g) Picture frame vertebrae → Paget's disease
h) Ivory vertebra → Paget's disease
   i. Lymphoma
   ii. Infection of TB
   iii. Myeloma / Metastasis
   iv. Paget's disease
i) Bamboo spine → ankylosing spondylitis

BONE TUMOR

03:34





- In simple bone cyst
  - Fallen fragment sign
  - Well defined lytic lesion
  - On metaphysis


Giant cell tumor

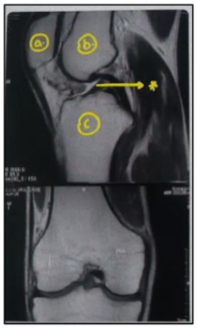
Osteosarcoma

- Sun burst pattern
- Sign of aggressive peristeal reaction
  - Metaphysis → osteosarcoma
  - Diaphysis → Ewing's sarcoma (onion peal appearance

MRI *05:27*

T22 - Fat image

- Lumbosacral spine MRI
  - Intervertebral disc → normal does not cross vertebral margin
  - PIVD : prolapsed intervertebral disc



a) Patella
b) Femur
c) Tibia
d) Ant. Cruciate ligament

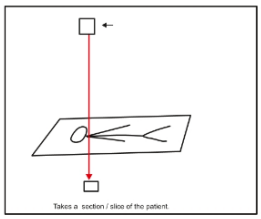
- Bucket handle tear
  - Tear of MM fragment seen in anterior to the PCL
  - Double PCL sign → bucket handle tear of medial meniscus

- ACL not seen → PCL gets buckled
  - Question mark sign
  - Feature of ACL tear

CT Scan

Active Space

- Invented by Goodfrey Hounsfield



- If something allow beams to pass → black color
- If something blocks beam → white color

- **HU scale** : Hounsfield unit → numerical value which is given to each tissue depending on degree of **attenuation** of x-ray by that tissue
- HU = 1000 x $\frac{\mu_x - \pi_{water}}{\mu_{water} - \pi_{air}}$
- μ is linear attenuation coefficient
- HU is predominantly dependent on μ

- HU values
  - +1000 → cortical bone (thick peripheral part of the bone) → most hyper dense
  - +100 → A/c hematoma
  - 30-40 : reference → liver, grey matter
  - 0 → water
  - -100 → fat
  - -1000 → air → most hypodense

IMAGE GENERATION ON CT *02:59*

- Most primitive - sequential CT / conventional CT
  - Each movement = 1 image

- Continuous rotation - spiral CT
- HRCT - high resolution CT scan
  - Slice thickness <1mm @ 10mm interval
  - Limited field of view
  - Bone algorithm is used for image reconstruction
  - Used in ILD, Miliary Tb & bronchiectasis

- Also used in temporal bone evaluation
  - View ear ossicles in CSOM
  - Temporal bone fracture
  - CSF leaf
- Most useful radiological investigation in Covid-19 : HRCT
- Earliest finding - peripheral areas of ground glass attenuation

SPIRAL CT

06:23

- Continuous imaging on gantry movement
- Development of slip ring technology
- Development → MDCT / MSCT

- Multidetector CT
  - Multiple detectors are placed
  - It can capture multiple images in 1 rotation
  - Improved resolution
  - Time taken - reduced

- Standard norm - MDCT / MSCT
- Volume reconstruction possible
- 3D imaging
- CT angiography is possible

- Development of phasic studies
  - Dye injected & multiple scans are taken
  - Depends on period of contrast enhancement
  - Arterial phase study / venous phase study / delayed study can be done

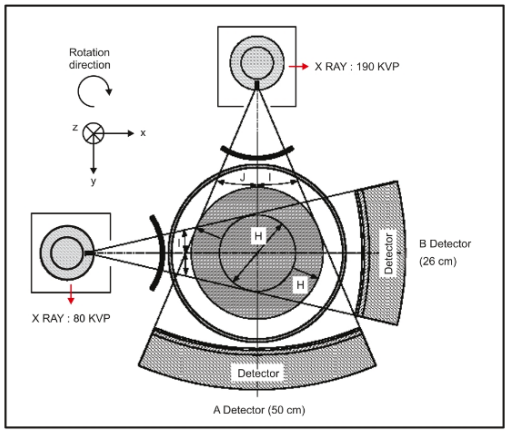
- Triphasic study - liver : Arterial, portal, delayed
- Any lesion in liver which shows arterial enhancement and portal venous washout is HCC
- Any lesion in liver which shows peripheral nodular enhancement in arterial phase with centripetal filling → hemangioma

Active Space

CORONARY ANGIOGRAPHY *10:09*

- >64 slice CT
- CT angiography in mid diastole phase
- Done under ECG gating
- Only possible if heart is beating 60-70 BPM
- If HR is 100 BPM → reduce HR
  - Give beta blockers
  - I.V esmolol / oral metoprolol

DUAL SOURCE CT *11:18*



- Different contrast & penetration
- Density of tissue is much better characterized

- **Advantages :**
  1) Characterization of renal stones
     - ESWL → soft stones
     - PCNL → PCNL
     - Hard stone cannot be broken by ESWL
     - Hard stone in kidney → cysteine → brushite → Ca oxalate monohydrate
  2) Coronary CT angiography can be done at any HR
  3) A prior NCCT is not required

Active Space

- Uses of CT

NCCT	CECT
Cortical bone	Staging of a tumor
Calculus / calcification	LN
Acute hemorrhage in brain	Infections, inflammation (chest & abdomen) and abscess (deep)
Air	Trauma → exceptions ↓
Head trauma	Unstable → USG : FAST CT angiography - CECT

Active Space

MRI

MRI VS CT

00:15

MRI	CT
	
Table and closed	Table and closed
Machine : big cylinder	Small
Patient goes in and remains in for the entire duration of the scan	Patient goes from one side and comes out from other side
Takes time in minutes	Time taken – seconds
Claustrophobia is an issue – fear of closed spaces	No such issues

MRI

01: 12

- Invented by Lauterbeur and Mansfield
- Principle : Gyromagnetism
- Lead shielding not required
- Machine is shielded with a cage of copper – Faraday's cage
- Strength is measured in Tesla

- Basic principle : based in magnetic movement in proton
  - Excitation & relaxation of proton generates different signals

- Relaxation time : time taken by proton to go from excitation to relaxation
  - T1 – measurement of longitudinal relaxation
  - T2 – transverse time

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- Image created

T_1W	T_2W
Longitudinal relaxation time	Transverse relaxation time
Anatomy	Pathology
TR : ↓↓	↑↑
TE : ↓↓	↑↑
Water is black	Water is white
Grey & white matter : grey is grey & white is white	Grey is white White is grey
Most of pathology : hypointense	Hyperintense

EXCEPTIONS

05:06

T_1 hyperintense (white)	T_1 & T_2 hypointense → signal void (black)
1) Fat 2) Blood products → subacute blood products 3) Proteinaceous substances 4) Melanin 5) Paramagnetic substances (Gadolinium)	1) Cortical bone MRI → black CT → white 2) Flowing blood in vessel 3) Calculus / calcification 4) Ligament, tendons and dense fibrous tissue 5) Hemosiderin (chronic hematoma)

STAGES OF HEMATOMA

06:30

Stages in hematoma	Time duration	Nomenclature	T_1	T_2
Oxyhemoglobin ↓	<6 hrs	Hyper acute	I	B
Deoxyhemoglobin ↓	6hr - 3 days	Acute	I	D
Meth Hb (intrinsic) ↓	3 days - 7 days	Early subacute	B	D
Meth Hb (extrinsic) ↓	7 days - 14 days	Late subacute	B	B
Hemosiderin	>2 weeks	Chronic	D	D

Active Space

MNEMONIC : In Bombay I Don't Buy Diary Milks Because Bombay Diary Milks are Dark
I = Iso
B = Bright
D = Dark

CONTRAINDICATIONS OF MRI *08:11*

- Absolute C/I
  1) Free lying ferromagnetic foreign body inside the body
     - Iron F.B inside the eye
     - Retained bullet in the body
     - Not orthopedic implants
  2) Cardiac pacemaker
  3) Hemostatic aneurysmal clips
  4) Cochlear implants
  5) Metallic cardiac valve
  6) Any magnetic device

- Relative C/I
  1) Claustrophobia
  2) 1st trimester of pregnancy

- Not C/I of MRI
  1) Orthopedic implants
  2) Cholecystectomy clips
  3) Sternal sutures
  4) IUCD
  5) Coronary stents → drug eluting

INDICATIONS OF MRI *09:58*

- Neural tissue → most useful Inx is MRI
  - Eg: Sciatica

- Cancellous bone / BM
  1) Intra osseous extend of skeletal tumor
  2) Acute osteomyelitis
  3) Stress fracture

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4) Avascular necrosis
5) Inflammatory conditions of bone like ankylosing spondylosis

- Cartilaginous
  - DDH:Development dysplasia of hip
  - OCD: Osteoclast defect

- Ligaments, tendons and dense fibrous tissue
  - ACL
  - Rotator cuff tear

Active Space

Radiation Hazards and Protection

RADIATION MEASUREMENT *00:19*

Dose	Conventional unit	SI unit
Exposure dose	Roentgen (R)	Coulombs /kg
Absorbed dose	RAD	Gray
Equivalent dose	Rem	Sievert
Effective dose		Sievert
Radio activity	Curie	Bacqueral

- 1 gray = 100 rads

SOURCES OF RADIATION *02:28*

- Background radiation
  - Universally present in atmosphere
  - Cosmic rays

- Man made source
  - Diagnostic equipment

Diagnostic procedure	Dose (msv)
Chest (single PA film)	0.02
Mammography	0.2-0.8
IVU	2.5
Barium enema	7
CT chest	8
CT head	2.3
CT abdomen	10
Bone scan	4

HARMFUL EFFECTS OF RADIATION *03:40*

- MC radiation S/E → skin erythema > fracture
- Eyes : most sensitive part of the eye for radiation → lens → cataract (post. subcapsular)
- Retina can also be involved
- Most sensitive part - retinal vessel endothelium > rods & cons
- Most resistant part of retina → retinal pigmented epithelium

Active Space

- Most resistant part of neurosensory retina → ganglion cell layer

- S/E of radiation - 2 types
  1) Deterministic
     - Dose dependent
     - Dose threshold exist
     - Dose related severity
     - Eg: cataract, alopecia, infertility
     - To eliminate → keep the dose below threshold

  2) Stochastic
     - Dose independent
     - No dose threshold
     - Probability event
     - Chance event : more dose → more chance
     - Eg: cancers, genetic S/E, teratogenicity
     - Probability can be reduced

RADIATION PROTECTION *07:18*

- Patient → exposed to direct radiation
  - ALARA approach : as low as reasonably achieveable
  - Radiation limit = 50 ms v/yr (no limit)
  - Based on risk benefit ratio
  - Radiation limit for pregnant pt.
  - During pregnancy = 5 ms v / term

- Radiation worker → scatter radiation
  - Protection - wear lead apron
  - Thickness = 0.5 mm
  - Measurement : TLD
  - Checked every 3 month
  - Guidelines : as per AERB
    - Occupational worker not exposed to >100 ms v / 5 yrs period with an annual equivalent of 30 ms v

- General public → background radiation
  - Guidelines : 1 ms v / year

Active Space

- Pregnant occupational worker
  - Badge given which should be placed on lower abdomen
  - The value should not go beyond 2ms v (50% - 1 ms v reaches the fetus)

Category	Dose limit (mSv)
Patient	50 mSv/yr
Occupational worker	100 mSv/yr
Pregnant patient	5 mSv/term
Pregnant occupational worker	2 mSv/declared term
General public	1 mSv/yr

Active Space

Contrast Agents in Radiology

Active Space

- **Contrast agents**: any external agent which enhances the differentiation
  1) Positive contrast : these agents make the tissue white in comparison to the background
     - Eg: all other contrast
  2) Negative contrast : those agents which make the tissue black in comparison to the background
     - Eg: water, air, mannitol

MRI CONTRAST AGENT *01:04*

- MC used → Gadolinium based contrast agents
- Free gadolinium is not used (toxic)
- Combined with compounds like DTPA
- No Iodine is present in MRI contrast
- Pharmacokinetics
  - Predominantly have renal excretion
  - Gadobenate dimeglumine & Gadoxetic acid → hepatic excretion

- Gadolinium
  - ↓ se T_1 relaxation time → signal on T_1W MRI ↑ses → T_1W - Hyper
  - ↓se T_2 relaxation time → signal on T_2W ↓ ses → T_2W - Hypo

- MRCP
  - No dye used in MRCP
  - Water in bile acts as dye
  - MRCP is T_2W MRI

- MRI contrast does not cross BBB
  - Dye in brain → brain in BBB
- Crosses placental barrier
  - C/I in pregnancy
- Excreted in breast milk
- Lactation should not be done for next 24 hrs

- Gadolinium S/E → nephrogenic systemic fibrosis
- Chronic scleroderma like illness
- Occur only in patients with chronic kidney disease

- Does not involve kidney, multisystemic disease
- GFR <30 → KFT should be measured before giving gadolinium

Active Space

USG CONTRAST AGENTS *04:19*

- Not the jelly → applied on the surface to eliminate air
- Levovist & sonoview → MC used contrast agents
- Gas filled microbubbles which are injected I/V
- Hyperechoic → increases echogenicity
  - Used for characterization of focal hepatic lesion
- It can be used in CKD patient

IODINATED CONTRAST AGENTS *05:29*

- Iodinated water soluble contrast agent (IWSCA) - used for all practical purpose
  1) Ionic (2 particles)
     a) Monomer - iodine : particle = 3 : 2
     b) Dimer - 6 : 2
  2) Non ionic (1 particle)
     a) Monomer - 3 : 1
     b) Dimer - 6 : 1

- Osmolarity classification

<table>
<tr><td></td><td>Ionic monomer</td><td>Ionic dimer</td><td>non-ionic monomer</td><td>Non-ionic dimer</td></tr>
<tr><td>Osmolarity</td><td>1600</td><td colspan="2">800</td><td>290-310</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">High osmolar contrast media
i) Urograffin
ii) Gastrograffin
iii) Ditrizoate</td><td rowspan="2">Low osmolar contrast media
i) Ioxaglate</td><td colspan="2">Iso-osmolar contrast media</td></tr>
<tr><td>i) Iohexol
ii) Iopamidol</td><td>i) Iodixanol</td></tr>
</table>

- Dianosil & Conray - Obsolete

- Common investigations which uses contrast media
  I/V
  1) Intravenous Pyelography (IVP)

2) CECT
NON_VASCULAR ROUTE
3) Micturating Cysto Urethrography (MCU)
4) Retrograde Urethrography(RGU)
5) Angiography - I/A
6) ERCP - local route

SIDE EFFECTS OF CONTRAST MEDIA *08:47*

- Most important - anaphylactoid reaction (anaphylaxis like)
- Non IgE mediated reaction
- Complement mediated H.S
- Rx : adrenaline I/M or deep S/C → 1 : 1000 dilution
- I/V may cause arrhythmias
- Only given when there is severe hypotension → 1 : 10,000

- Contrast induced nephropathy
  - Deterioration of renal function because of contrast media
  - Increase by >0.5 mg/dL

- Cause of contrast induced nephropathy
  - I.V / I.A → excreted through kidney → increases osmotic overload
    - Kidney function normal → nothing
    - Kidney function abnormal → constriction of afferent arterioles → renal ischemia → ↓ GFR

- Factors responsible for CIN
  1) Excretion through kidney
  2) Pre-existing renal disease
  3) Osmolarity of contrast media

	Mode of route		KFT measured
	I.V / I.A →		KFT
IVP	Y		Yes
CECT	Y		
MCU	N	Ionic	No
RGU	N		

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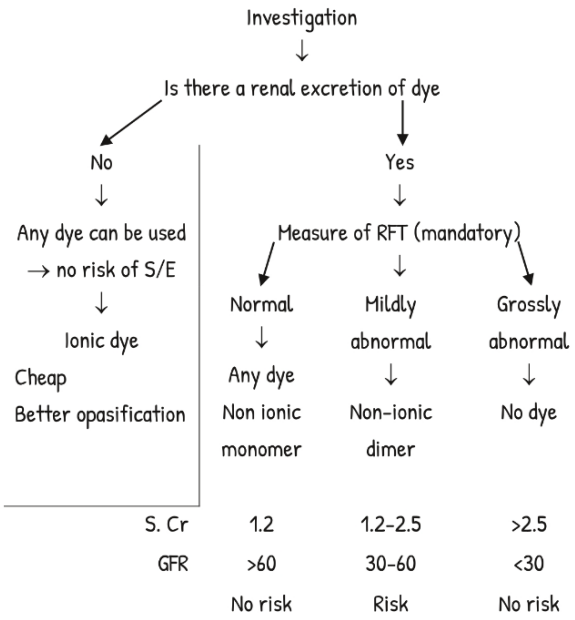
HSG	N	Ionic	
Angiography	Y		Yes
ERCP	N	Ionic	No

FLOW CHART FOR USE OF CONTRAST *11:58*



METHODS TO PREVENT CONTRAST INDUCED NEPHROPATHY *13:01*

- Adequate hydration of patients
  - I.V N saline
- Use of iso osmolar / low osmolar contrast media
- Drugs :
  - $NaHCO_3$
  - Ascorbic acid
  - Theophylline
- Mannitol & diuretics are not effective in prevention
- Hemodialysis is not effective
- Hemofiltration has some protective effect

Active Space

Contrast Agents in Radiology

Topic Notes: 5

- GIT → use oral contrast - $BaSO_4$

- C/I of $BaSO_4$
  1) Small bowel obstruction → formation of barium stones
     - Preferred dye - iodinated ionic dye
     - Gastrograffin

  2) Suspected intestinal perforation
     - Preferred dye : gastrograffin > Iohexol

  3) Trachea esophageal fistula
     - Gastrograffin → highly osmolar → draws water from pulmonary circulation → pulmonary edema
     - Preferred - Iohexol

- In esophageal perforation - gastrograffin can be used

- Myelograph : dye injected in thecal sac
  - Non-ionic dye is preferred
  - Due to risk of arachnoditis with other dye

Active Space

Nuclear Scan and PET Scan

NUCLEAR SCAN

00:19

Active Space

- Nuclear scan uses gamma rays
- Radiopharmaceutical compound is used – Tc_{99}^{m}
- Isomeric transition : $Tc_{99}^{m} \rightarrow Tc_{99}$
- Energy of gamma rays = 140 KeV
- Half life = 6 hrs

- Tc_{99}^{m} + DTPA used to estimate GFR
- Tc_{99}^{m} + MAG-3 → excreted
  - Glomerular filtration
  - Tubular secretion
  - Better measure of renal function

- Tc_{99}^{m} DMSA → taken up by the functioning renal tissue → outlines the kidney
  - Structure / scar can be assessed

- Distribution of renal function → DMSA

- Tc pertechnate → affinity
  - Gastric mucosa – Meckel's diverticulum
  - Salivary gland – Warthin's tumour
    - Hot spot is seen
  - Thyroid gland

- Hot spot : ↑ activity → black
- Cold spot : ↓ activity → white

- Thyroid gland → I_{123} is used

	I_{123}	I_{131}	I_{125}	I_{127}
$t_{1/2}$	13 hrs	8 days	Radio immune assay ↓ 60 days	Not radioactive
Rays emitted	Gamma ↓ Scanning	Beta + gamma ↓ Destroy the gland		
Uses	Radioactive iodine uptake	Thyroid ablation		

AGENT USED FOR DISEASE *05:11*

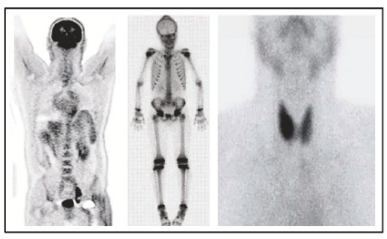
- MIBG scan → pheochromocytoma
- Sesta MIBI → parathyroid adenoma
- HIDA → biliary atresia
- MDP → bone scan - measurement of osteoblastic activity
- Selenium methionine → pancreatic imaging
- Octreotide scan → SRS → neuroendocrine tumor
- RBC scan → GI bleed
- Thallium scan → myocardial viability & reversibility of myocardial ischemia
- MUGA scan → ventricular function

SPECT *06:09*

- Single photon emission CT
- CT of nuclear scan is SPECT

PET SCAN *06:42*

- Positron emission tomography
- Tc is not used
- MC used agent 18FDG
- $t_{1/2}$ → 110 mins
- FDG is a marker of glucose metabolism
- Energy of gamma rays generated = 511 KV → annhilation
- Before PET scan - glucose measured
- Brain & brown fat normally show high activity
- Cancers that do not show activity on FDG PET
  - Typical carcinoids
  - Broncho alveolar carcinoma
- Diseases which mimics cancer on PET → infection / inflammation like TB

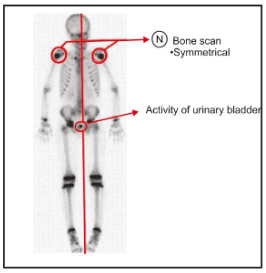


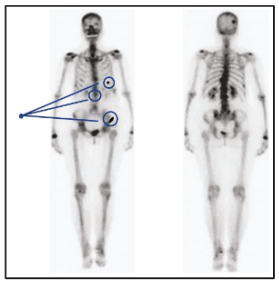
PET scan Bone Thyroid

Active Space

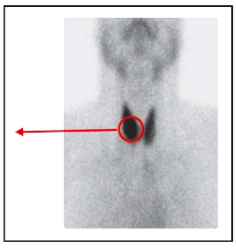
HOW TO IDENTIFY DISEASE ON SCAN

09:22





Skeletal metastasis



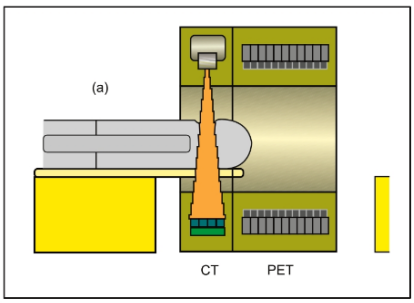
Hot nodule → Toxic adenoma

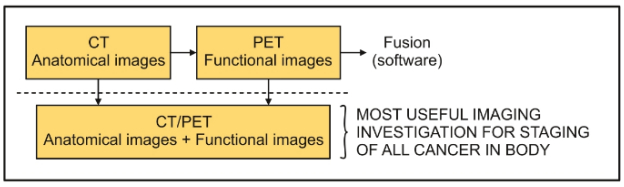
- Cancers → cold nodule
- Grave's disease → diffused increase uptake
- Latent aberrant thyroid→ LN (metastatic)

Active Space

PET – CT SYSTEM

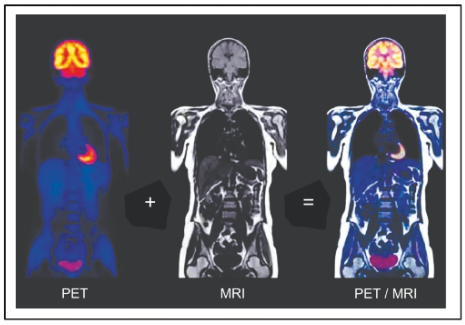
10:35





- PET-CT → anatomy + function
- Most useful imaging Inx for staging of all cancers in the body

- PET-MR



UPDATES

11:51

- 18FDG
- 18F DOPA PET
  - Parkinsonism
  - Pheochromocytoma

- Aβ amyloid PET → Alzheimer's disease
- Ga_{68} PSMA → prostrate cancer metastasis

Active Space

- Ga_{68} DOTA TOC, Ga_{68} DOTA NOC, Ga_{68} DOTA TATE
  - Somatostatin analogues

- Cardiac perfusion agent
  - ^{15}O
  - ^{13}N
  - ^{82}Rb

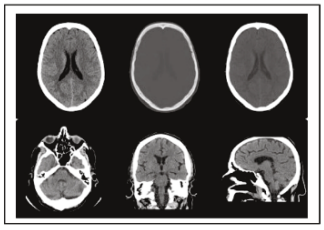
Active Space

CT vs MRI and MRI Sequences

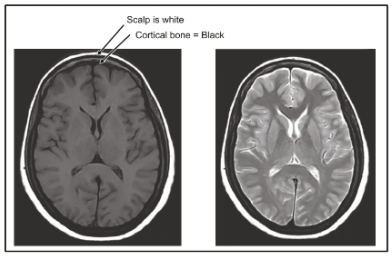
CT VS MRI

00:27

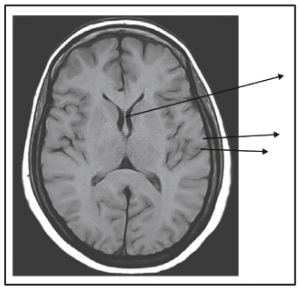
- Cortical bone is always white on CT and black on MRI



CT



MRI

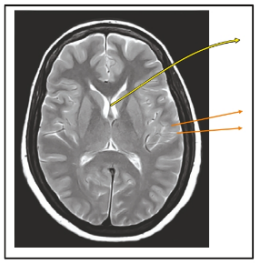


- CSF is black – T_1W MRI
- Grey is grey
- White is white
- To study anatomy

Active Space

CT VS MRI & MRI SEQUENCES

Topic Notes: 4

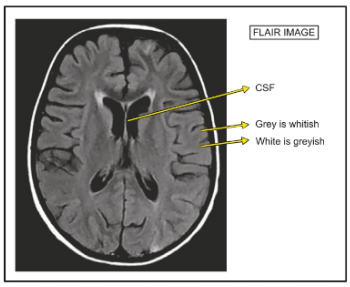


- CSF is white - T_2W MRI
- Grey is white
- White is grey
- To study pathology

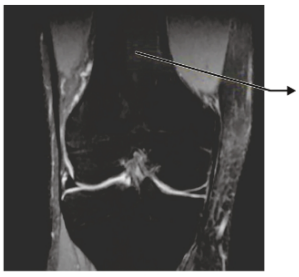
IMPORTANT SEQUENCE OF MRI

02:23

- Flair - fluid attenuated inversion recovery sequence
- T_2 - H_2O
- Used in brain



- Suppresses CSF
- It differentiates edema



STIR MRI

Active Space

CT VS MRI & MRI SEQUENCES

Topic Notes: 4

T_2 – fat

- BM imaging
- White → pathology
- Used in rest of the body except brain

- DWI – diffusion weighted imaging
  - Special type or MRI sequence which assess the Brownian motion of water molecule
  - This is called restricted diffusion

DWI

- Most common cause → acute ischemic infract
  - High cellular tumor
  - Epidermoid cyst → DWI > FLAIR
  - Abscess
  - Encephalitis

- TOF – time of flight imaging
  - MRI – angiography → dye used gadolinium
  - Can be done without dye → TOF

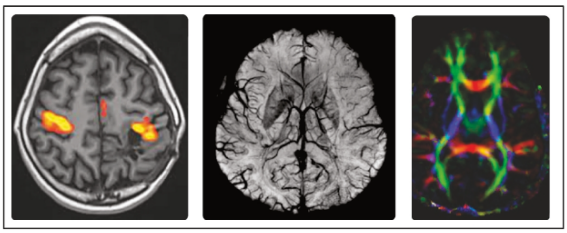
- SWI – susceptibility weighted imaging
  - Used to pick up hemorrhage and calcification
  - Inx OC : pickup micro hemorrhages

- Functional MRI
  - BOLD → blood oxygen level dependent
  - Used to pick up eloquent cortex in the brain
    - Motor cortex

Active Space

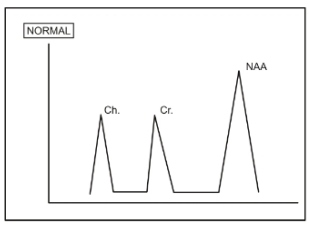
- Language cortex
- Visual cortex

- MR tractography
  - Delineates white matter tract
  - Done with Diffusion tensor imaging (DTI)



SWI Bold MR tractography

- MR spectroscopy
  - Assess the biochemical or metabolic environment of the tissue
  - NAA → N-acetyl aspartate
    - Marker of neuronal integrity
    - Decreased in all brain disorders
    - Canavan's disease → ↑sed
  - Choline → marker of cell membrane turn over
    - Marker of cell division
  - Creatine → phosphocreatine → present in ATP
    - Marker of energy stores
    - Stable marker



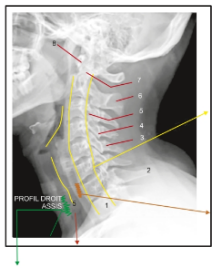
- Lipid lactate peak on MR spectrography is tuberculoma

Active Space

Head and Neck Radiology

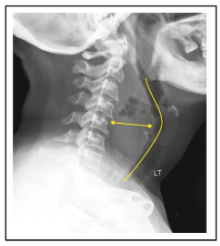
SPINE IMAGING

00:19

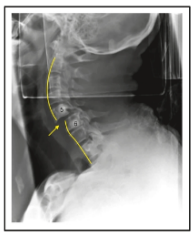


Radiograph of lateral projection of spine

- Retropharyngeal soft tissue → retropharyngeal abscess
- Pre-tracheal soft tissue thickening → thyroid enlargement

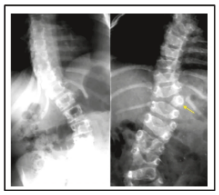


Retropharyngeal abscess



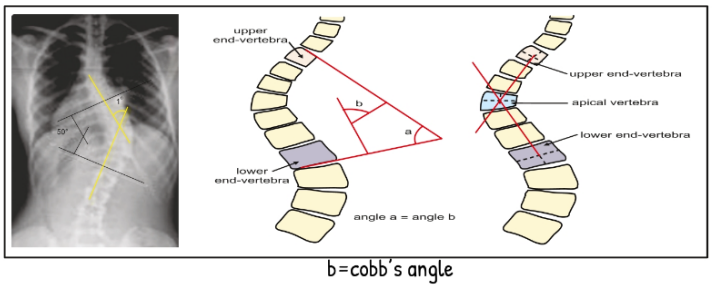
Anterolisthesis of C5 over C6 vertebral body

Scoliosis



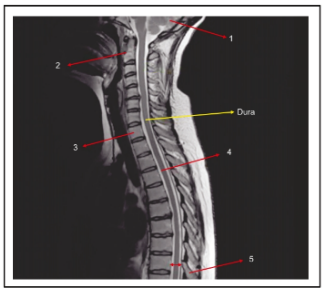
Idiopathic Congenital

Active Space

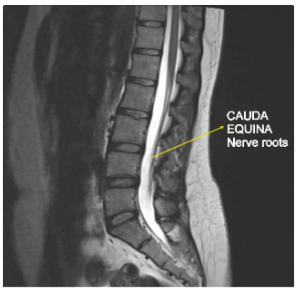


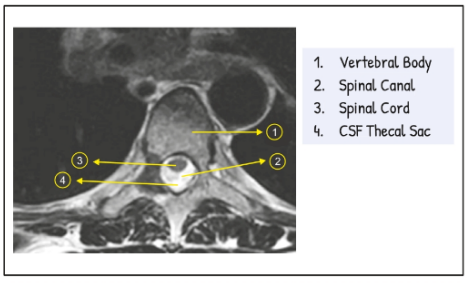
b=cobb's angle

- In patient with scoliosis - measure amount of scoliosis
- Measured in Cobb's angle

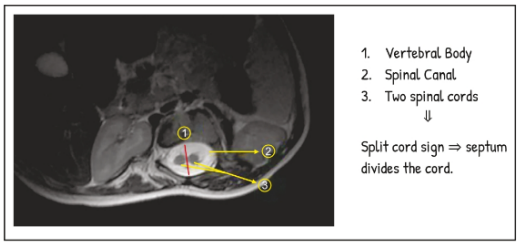


MRI of spine → T_2W MRI

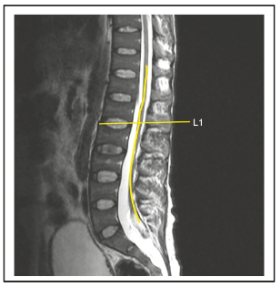




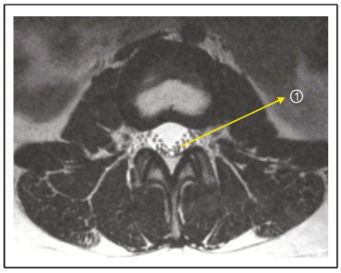
Active Space



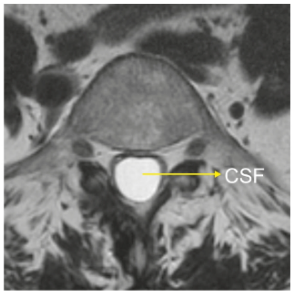
Diastematomyelia



Tethered cord → low lying cord



Section below L1



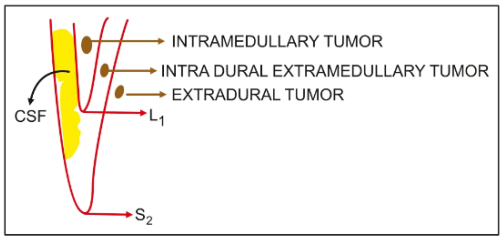
Section at L3

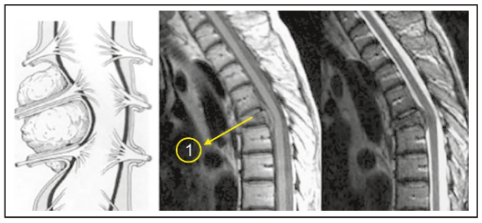
Empty thecal sac sign → arachnodidtis

Active Space

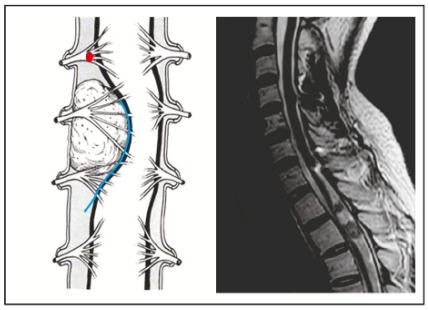
SPINAL CORD TUMORS

05:16





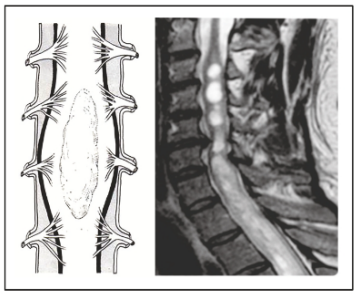
Extradural



Intradural

- Subarachnoid space widening-hallmark
- From nerve root
  - Neurofibroma
  - Schwannoma
- Form dura
  - Meningioma

Active Space

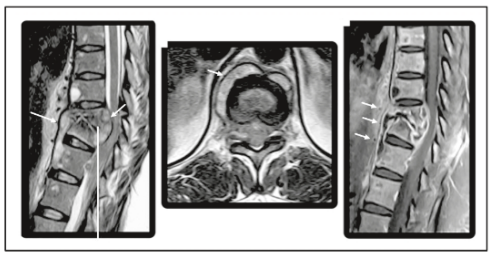


Intramedullary lesion

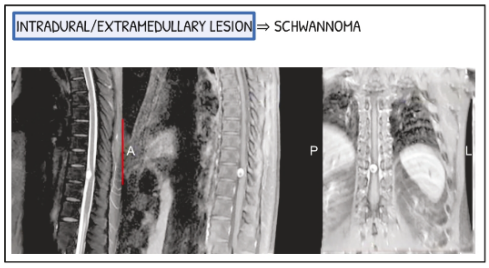
- DD
  - Astrocytoma
  - Ependymoma
  - Hemangioblastoma

POTT'S SPINE

06:33



- MC infection → TB
- Predominantly extradural lesion

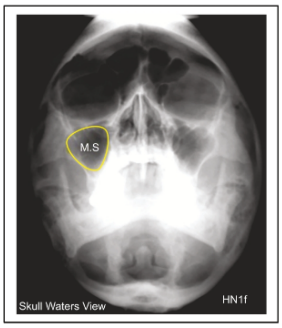


Active Space

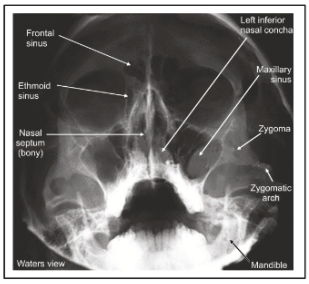
FACE AND PNS IMAGING

07:09

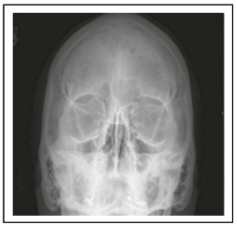
Active Space



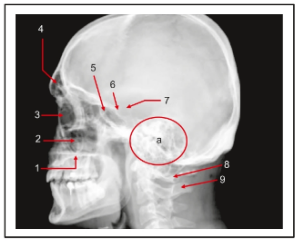
Water view



Pierre's view → water view with open mouth



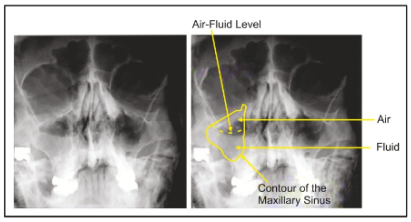
Cadwells view



Lateral view

ABNORMALITIES IN FACE RADIOGRAPHY

08:12



Acute sinusitis

Tear drop sign → sign of blow out fracture

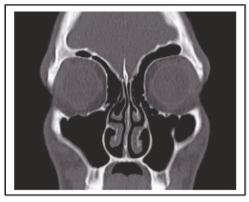
Bare orbit sign / empty orbit sign

↓

Seen in neurofibromatosis 1

CT SCAN OF PNS

09:00

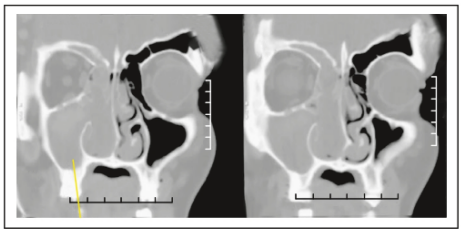


Active Space

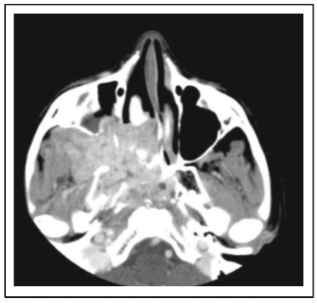
Coronal plane CT scan

Inc OC for sinus disease

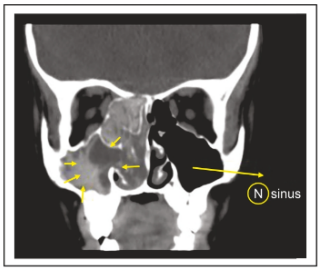
Chronic sinusitis



Antro choanal polyp



Angiofibroma



Antral sign/ Halman Miller sign: anterior boundary of posterior wall of M.S

Active Space

Hyperdense content in sinus → fungal sinusitis

Double density sign

Orthopantomogram

Entire mandible can be seen

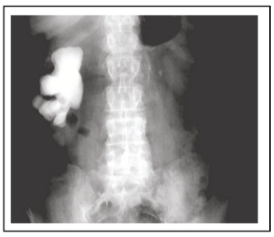
Active Space

Genitourinary Radiology

Active Space

- Common investigations
  1) Radiography
  2) IVP
  3) CT scan

RADIOGRAPHY *00:27*



Staghorn calculus

- Renal stones
  - Opaque (90%)
    - Ca oxalate
    - Triple phosphate
    - $CaPO_4$
    - Cysteine
  - Radioluscent (10%)
    - Uric acid
    - Xanthine
    - Indinavir
    - Trimtrene

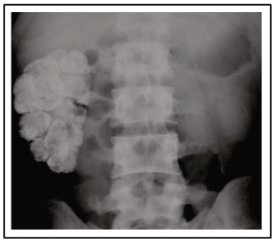
- Hardness of stone
  - Hardest : cysteine > brushite > Ca. oxalate monohydrate
  - Diagnosis → NCCT
  - Characterization → dual source CT

- Staghorn calculi
  - Seen in alkaline urine
  - Usually infected
  - MC organism : Proteus mirabilis

- Patients develop → xanthoma granulomatous pyelonephritis
- Biopsy → xanthoma cells look similar to clear cells

Active Space

02:45

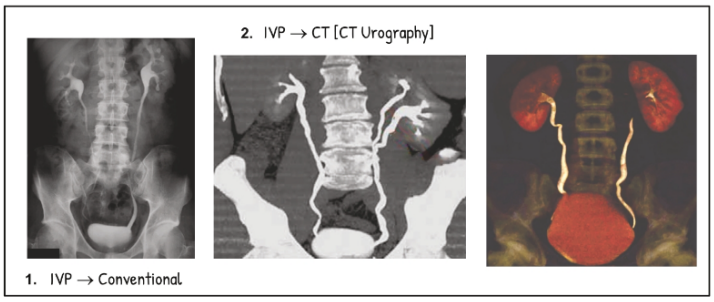


RENAL TB

03:08

- MC symptom of renal TB → frequency
- MC sign of renal TB → sterile pyuria
- MC radiological feature → blurring of papillary outline

MC radiological feature → blurring of papillary outline 3D



IVP

COMMON GENITOURINARY IMAGES

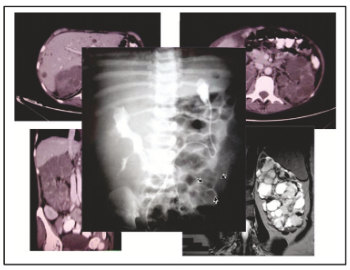
03:52

Horseshoe kidney / joining hand sign / flower vase appearance

Crossed ectopia

Duplicated system

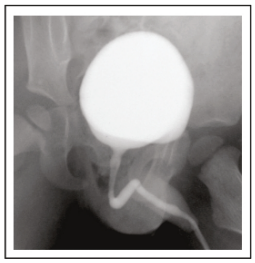
Cobra / adder head appearance → ureterocele



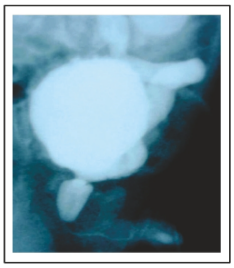
Polycystic kidney disease → multiple cyst

Spider leg appearance → IVP of PCKD

Active Space

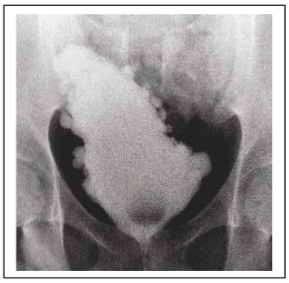


Normal MCU



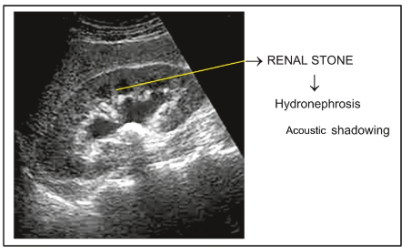
Key hole appearance → posterior urethral valve

Vesicoureteric reflex

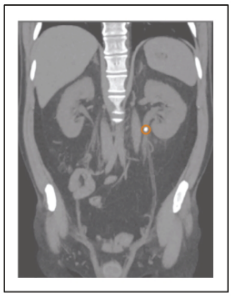


Christmas tree bladder → neurogenic bladder

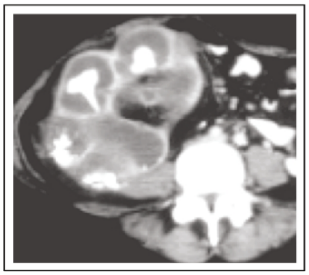
Active Space



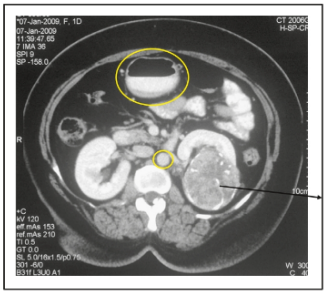
USG of kidney → renal stone



CT scan → left ureteric stone



Beer paw sign → ramification of staghorn calculus



CECT

Fat containing lesion in kidney → angiomyolipoma

Active Space

ADRENAL GLAND

07:02

- Location : b/w kidney and liver
- Adenoma
  - Rich in microscopic fat
  - HU value <10 on NCCT
  - Fat poor >10

- CT scan adrenal protocol → microscopic fat pick up
  1) NCCT
  2) CECT
  3) 15 mins delayed CT

- Any lesion in the adrenal gland which shows rapid uptake of contrast and rapid washout is adenoma
- Any lesion in the adrenal gland which shows rapid uptake, contrast stays longer time and washes out late is metastasis
- MRI → chemical shift imaging can detect microscopic fat
- Metastasis shows increase activity in FDG-PET

- Pheochromocytoma
  - 10% rule
    - 10% → B/L
    - Extra adrenal
    - Malignant
  - Diagnosis is clinical
  - Supported by laboratory
  - Radiology localize the site of pheochromocytoma
  - Extra adrenal pheochromocytoma → MIBG
  - Best investigation → DOPA PET
  - MRI : T2W → light bulb appearance

Active Space

Women's Imaging

ANC : ANTENATAL SCANNING

00:57

Active Space

- Earliest investigation used for confirmation of pregnancy → β HCG
- Earliest investigation used for confirmation of IU pregnancy → TVS
- Viability → cardiac activity → TVS @ 5.5 weeks

- 1st USG in pregnancy → Dating scan @ 6 weeks
  - Confirms pregnancy
  - Viability
  - No. of gestations sac
  - Expected date delivery
  - No congenital abnormal picked up

- Earliest congenital Ab(N) → anencephaly @ 8(8-10) weeks
  - Ossification of frontal bone

- 2nd scan → nuchal scan → 11-13 weeks
  - Nuchal translucency
  - Nasal bone (both are markers for Downs syndrome)

- NIPT & non invasive prenatal testing
  ↓
  Maternal blood
  ↓
  Cell free fetal DNA
  ↓
  Karyotyping

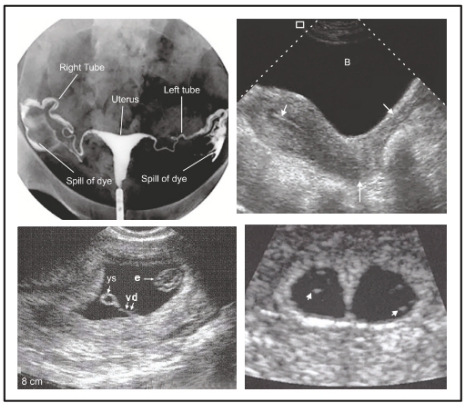
- Test for structural abnormality → 3rd scan → USG : 18-20 weeks
  - Anomaly scan → most important scan
  - To assess gross congenital abnormality
  - Most useful scan in pregnancy

- 4th scan : growth scan → 28-32 weeks look at fetal growth
  - Doppler

- Most important parameter for fetal growth
  - 1st T → CRL
  - 2nd T → BPD
  - 3rd T → EFW / Femur length

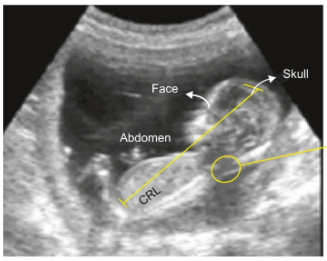
- Most sensitive parameter for IUGR → abdominal circumference > 2 weeks

- Doppler : we study the following
  - Maternal uterine artey
  - Umbilical artery
  - Fetal MCA
  - Ductus venosus
  - Aortic isthmus



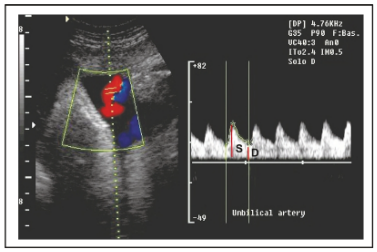
1) Normal HSG
2) N uterus
3) Gravid uterus - single pregnancy
4) Gravid uterus - twin pregnancy (lambda sign - dichorionic pregnancy)

Anencephaly

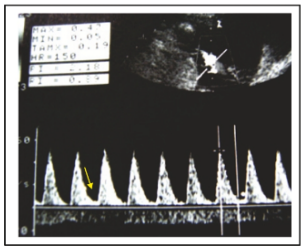


Fetus in USG

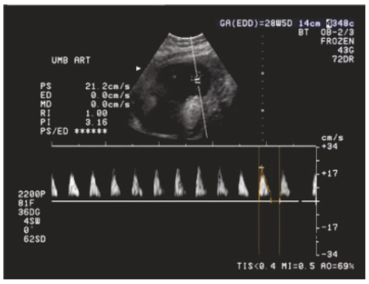
Active Space



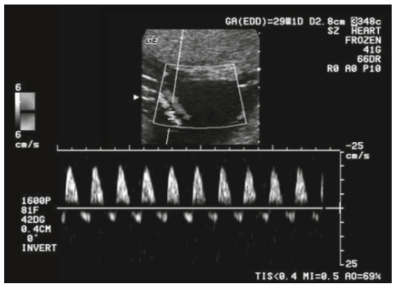
Doppler : normal



Decrease in diastolic flow

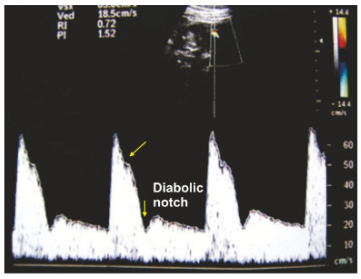


Diastolic flow - baseline
Sign of severe IUGR
<34 week → steroid
>34 week → termination

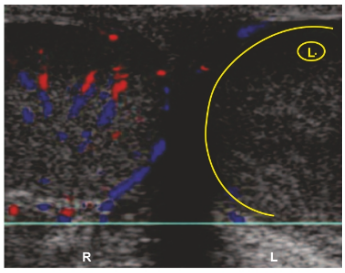


Reversal of diastolic flow

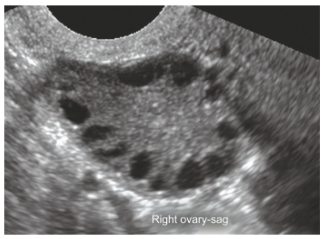
Active Space



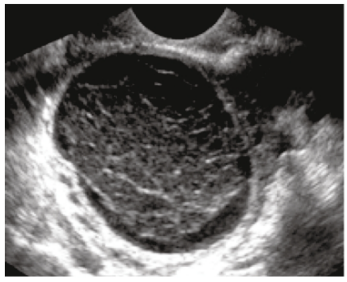
Uterine artery doppler



Doppler of scrotal sac → absence of vascularity - testicular torsion

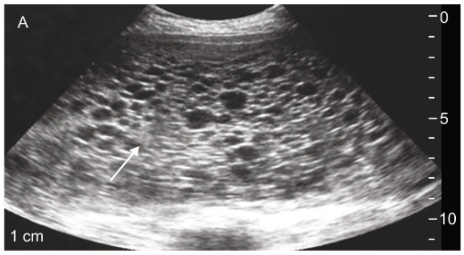


PCOS



Fish net appearance → hemorrhagic cyst : ovary

Active Space

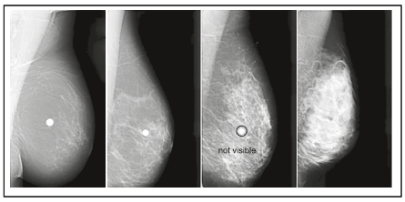


Snow storm appearance → Hydatidiform mole

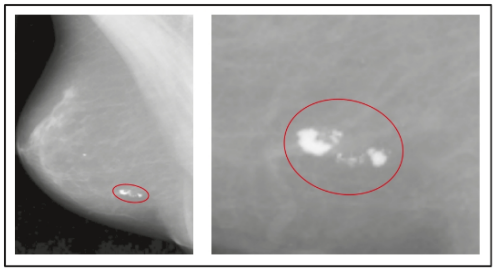
BREAST IMAGING

10:00

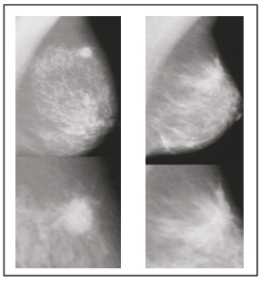
Mammographic images



- Mammography should be done in older females

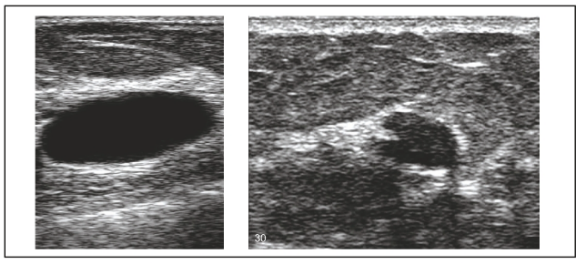


Fibroadenoma → pop corn calcification



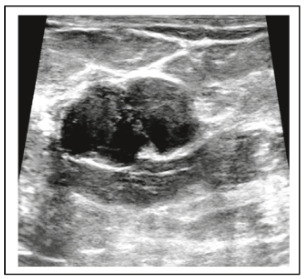
Spiculated lesion

Active Space

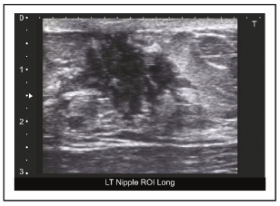


Simple cyst Solid cyst

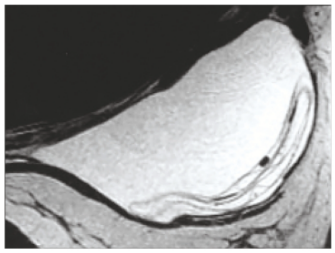
- Solid → well defined, wider & taller → benign
- Solid → irregular & taller → malignancy - assessed by biopsy



Benign lesion



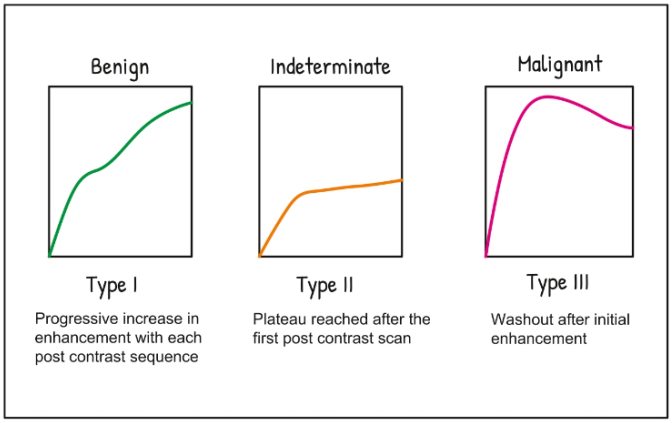
Irregular lesion



Linguine sign

Seen in intracapsular rupture of breast implant

Active Space



Seen in Dynamic Contrast MRI

Active Space

Radio Therapy

RADIATION INTERACTION WITH MATTER 00:16

- Photoelectric effect
  - Interaction with innermost shell
  - Low energy - energy sufficient to remove e^-
  - Innermost e^- is bound e^-
  - There is complete transfer of energy
  - Responsible for diagnostic radiations in radiology

- Compton effect
  - High energy interaction
  - It is the interaction with the outermost shell
  - Interaction with free e^-
  - Incomplete transfer of energy
  - Scatter radiation in radiology

- 3 types
  1) Teletherapy
  2) Brachytherapy
  3) Systemic therapy

- Teletherapy
  - From a distance
  - Non invasive
  - Commonly used : Co 60 & Cs 137 → gamma emitters
  - Linear accelerator (LINAC) → high energy x-ray tube
    - With anode → x-rays
    - Without anode → e^-
  - Electron
    - Low penetrating power
    - Used for Superficial cancer
    - Mycosis fungois
    - IORT
  - X-rays (cyber knife therapy) & gamma rays (gamma knife therapy) → deep cancers

Active Space

- Photons are also used in teletherapy
  - Follow inverse square law : intensity of radiation will decrease by square of distances as it increases
  - Proton beam therapy utilizes is concept of Bragg's peak

- Rays used in teletherapy
  - X-rays
  - Gamma rays
  - Electron
  - Proton beam

- Stereotactic radiosurgery : form of teletherapy → radiotherapy
- Treats the precise location of the tumor
- Used for localized cancers
- Used for deep cancers

BRACHYTHERAPY *05:58*

- Radioactive source placed inside the organ
- Types
  1) Interstitial - in the form of pins & needles, radioactive source is present inside the body (m/c)
  2) Intracavitatory - placed inside the cavity
     - Gynecological cancer - Ca cervix, endometrial Ca
  3) Mould - source placed like a mould
     - Skin cancer
     - Ocular cancer

SYSTEMIC THERAPY *05:44*

- Systemic administration of radioactive material
- I^{131} (beta rays) used for well differentiated thyroid cancer
- P-32 → used for polycythemia vera

  Rest all are gamma

Emission of beta rays by	Both beta + gamma rays
Ytterium	Gold
Phosphorus	I^{131}
Strontium	Radium

Active Space

	Most	Least
Stage of cell cycle	G2M > M	S → most sensitive to heat
Organ	Ovary, testis	Vagina > bones > CNS
Tissue	BM	Nervous tissue
Cell type Law of Bergonie	Undifferentiated, well nourished, divide quickly and are highly metabolically active	Quiescent
Blood cell	Lymphocyte	Platelet
Retina	Retinal vessel endothelium	

RADIOSENSITISERS *08:28*

- Agent that makes the tissue more sensitive to radiation
- Chemotherapeutic agents
  - Metronidazole
  - Hyper baric oxygen

- Radioprotector:
  - Amifostine
  - IL-1
  - GM-CSF

HALF-LIFE *09:00*

- Ir-192 → 74 days
- 18 FDG → 110 mins
- Tc99 → 6 hrs
- I-123 → 13 hrs
- I-125 → 60 days
- I-131 → 8 days
- I-132 → 2.3 hrs
- P-32 → 14 days
- Co-60 → 5.2 years
- Ra-226 → 1622 yrs

Highly sensitive	Least radio sensitive
Wilms	Hepatoma
Ewings	Osteosarcoma
Lymphoma	Melanoma
Myeloma	Pancreatic carcinoma
Seminoma	

Rest are all intermediate

Active Space

RADIOSENSITIVITY OF TUMORS

09:42

- Highly sensitive
  - Wilms
  - Ewings
  - Lymphoma
  - Myeloma
  - Seminoma

- Least sensitive
  - Hepatoma
  - Osteosarcoma
  - Melanoma
  - Pancreatic carcinoma

Active Space