

# RADIOLOGY REVISION 1

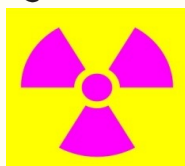
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## Introduction to Radiations

00:00:10

Wilhelm Rontgen : Discovered X-rays.

Symbols :



Radiation hazard  
Trefoil : Fan with 3 leaves

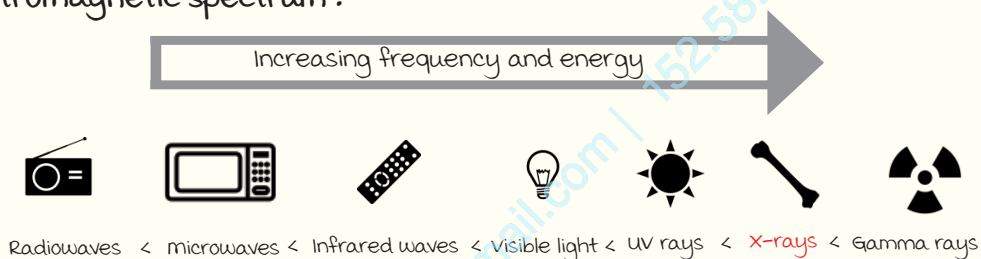


X-ray radiation  
hazard



Sealed radiation  
source

Electromagnetic spectrum :



The Electromagnetic spectrum

Radiation units :

| Parameter                | Conventional unit | SI unit    |
|--------------------------|-------------------|------------|
| Radiation exposure       | Roentgen          | Coulomb/kg |
| Absorbed dose            | Rad               | Gray       |
| Absorbed dose equivalent | Rem               | Sievert    |
| Radioactivity            | Curie             | Becquerel  |

## Effects of Radiation

00:09:15

Law of radiobiology/law of Bergonie & Tribondeau : Tissues with max. undifferentiated cells or cells in active mitosis are more radiosensitive.

Acute Radiation Syndromes :

| Absorbed dose | Acute Radiation syndrome     |
|---------------|------------------------------|
| 1-2 Gy        | Acute hematological syndrome |
| 6-10 Gy       | Acute GIT syndrome           |
| 20 Gy         | Acute CNS syndrome           |

Bone marrow cells are most radio sensitive.

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Adverse effects of radiation on the body :

|                | Deterministic Effect   | Stochastic Effect   |
|----------------|--|---|
| Examples       | Acute radiation syndromes.<br>Cataract.<br>Skin effects.<br>Sterility. | Carcinogenesis.<br>Mutations.<br>Chromosomal aberrations. |
| Onset          | Acute to subacute.   | Chronic.  |
| Threshold dose | Present.   | Absent.   |
| Severity       | ↑ with an ↑ in radiation dose.   | No change with change in radiation dose.                  |

## Radiation exposure

00:18:46

| Color  | Radiation exposure | Examples   |
|--|--------------------|--|
| Red (CT/PET/<br>Radionuclides)<br>Note : Used with<br>caution in children. | High               | <ul style="list-style-type: none"> <li>PET scan (35 mSv).</li> <li>CT abdomen (10 mSv).</li> <li>CT thorax (8 mSv).</li> <li>Bone scan.</li> <li>CT head/brain (3.5 mSv).</li> </ul>   |
| Yellow (Diagnostic<br>procedures)  | Intermediate       | <ul style="list-style-type: none"> <li>Ba enema (7 mSv), Ba meal follow through, Ba meal, Ba swallow.</li> <li>Intravenous urography.</li> <li>micturating cystourethrogram (1.2 mSv).</li> </ul>                              |
| Green (Spot<br>radiographs)  | Low (Safe)         | <ul style="list-style-type: none"> <li>CXR PA view (0.02 mSv) : m/c used.</li> <li>Lumbar spine (1.0 mSv).</li> <li>Abdominal X-ray.</li> <li>Hip AP view.</li> <li>Skull AP.</li> <li>Limb/joint X ray (0.01 mSv).</li> </ul> |

ICRP/ICRU radiation exposure guidelines :

|                                       | Public exposure                        | Occupational exposure  |
|---------------------------------------|--|--|
| Effective dose                        | 1 mSv/year                             | max in 5 years : 100 mSv.<br>Allowed : <ul style="list-style-type: none"> <li>20 mSv/year averaged over 5 years.</li> <li>max 50 mSv in any one year.</li> </ul> |
| Annual equivalent dose to lens of eye | 15 mSv.                                | 150 mSv.   |
| Annual equivalent dose to skin        | 50 mSv.                                | 500 mSv.   |
| For pregnant radiation workers        | Zero, but permissible dose of < 1 mSv. |  |

Note :

- Accidental chest X-ray in a pregnant lady → Reassurance and continue pregnancy.
- Atomic Energy Regulatory Board (AERB) guidelines : Max exposure in a year is 30 mSv/year but maximum exposure in 5 years is 100 mSv.

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## X-ray tube structure and functions

00:27:40

Working principle of x-ray tube : Thermionic emission.

Types of emissions from anode :

|           | Continuous spectrum   | Characteristic spectrum   |
|-----------|---|---|
| Amount    | 70-80 % (m/c).  | 20-30 %.  |
| Mechanism | Kinetic energy lost from deflection/ deceleration of electrons is converted to x-ray. | Emitted electron knocks out inner shell electron creating a vacancy for outer shell electron to jump in and the energy lost is converted as an x-ray. |
| uses      | most of the radiological procedures.  | mammography.  |

Note : Continuous spectrum radiation is also called as braking radiation/white radiation/Bremsstrahlung radiation.

Interactions of x-rays with matter :

00:35:20

Compton v/s Photoelectric effect :

|                | Compton effect (m/c)  | Photoelectric effect (2 <sup>nd</sup> m/c)                           |
|----------------|---|--|
| Aka            | mid energy phenomenon.  | Low energy phenomenon.   |
| MOA of effect  | Deviation of x-ray photon (Scatter radiation) as it strikes the outer shell electron. | Absorption of x-ray photon by the inner shell electron.              |
| Applied aspect | Causes image distortion → So, minimize Compton effect.                                | Improves image quality/contrast → So, maximise Photoelectric effect. |

## Exposure factors

00:40:49

Kilo voltage peak (kvp) :

Peak potential difference between cathode and anode.

Determines :

- Penetration of the x-ray beam (Directly proportional).
- Image contrast (Inversely proportional).

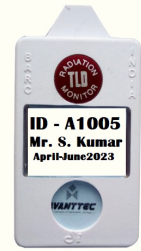
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milliampere-second (mAs) :

Current passing through the X-ray tube for a set duration of time.  
Determines → Film blackening or contrast (Directly proportional).

Thermoluminescent Dosimeter (TLD) badge :

Department personnel radiation exposure monitoring device.



TLD Badge

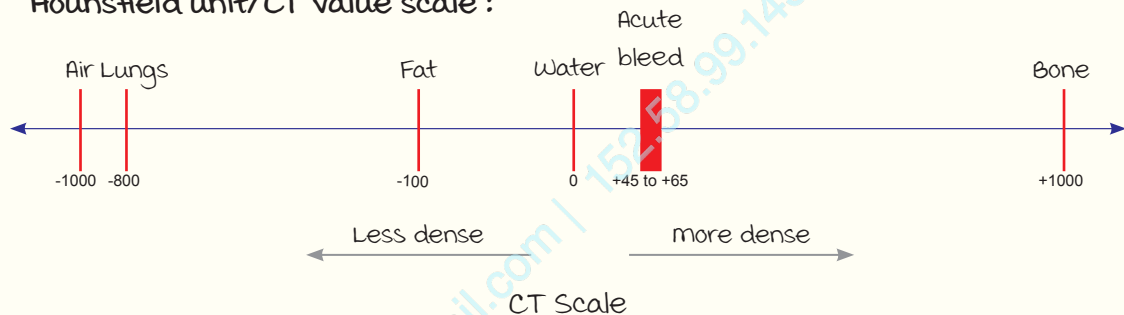
## Computed Tomography (CT)

00:48:11

Founding father of CT : Sir Godfrey Hounsfield.

Lining of the equipment room : 1/16th inch of lead all around (Or) 4-6 inches of concrete.

Hounsfield unit/CT value scale :



Total HU : 2000 shades of grey.

CT Polytrauma/whole body CT/Pan-scan :

Standard protocol :

- Non contrast CT of the head + cervical spine.
- Contrast enhanced CT of the chest + abdomen + pelvis.

Note : Body part not included in the protocol → Limbs.

## Ultrasonogram

00:57:01

Ultrasonic : > 20,000 Hz.

Ultrasound spectrum in diagnostic practice : > 1 mega Hz.

USG basic principle :

m/c piezoelectric crystal : Lead zirconate titanate.

- **Reverse** piezoelectric effect : Electric current passing through the crystal produces vibrations in the tissues.
- **Piezoelectric effect** : vibrations reflected by tissues are converted back into electric impulses.

## Magnetic Resonance Imaging

01:00:35

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Basic principle :

Gyromagnetic property of hydrogen nucleus (Strongest gyromagnetic property).

Contraindications of MRI :

| Absolute  | Relative  |
|---|---|
| 1. Cardiac pacemaker.<br>2. Cochlear implant.<br>3. metallic foreign body in the eye.<br>4. Ferromagnetic CNS aneurysm clips. | 1. Claustrophobia (Can be performed after sedation).<br>2. Devices : Insulin pumps/nerve stimulators, epidural catheters, prosthetic heart valves.<br>3. 1 <sup>st</sup> trimester of pregnancy (Loud noise while scanning → may cause deafness in the developing fetus). |

Note : Faraday's cage : Copper wires wrapped around wooden panels to prevent the magnetic field from interacting with outside environment.

## Contrast Media

01:07:05

X-rays/CT : Barium and iodine.

USG : Stabilised microbubbles.

MRI : Gadolinium (m/c).

Barium :



Ba swallow



Ba meal



Ba meal



Ba enema

follow through

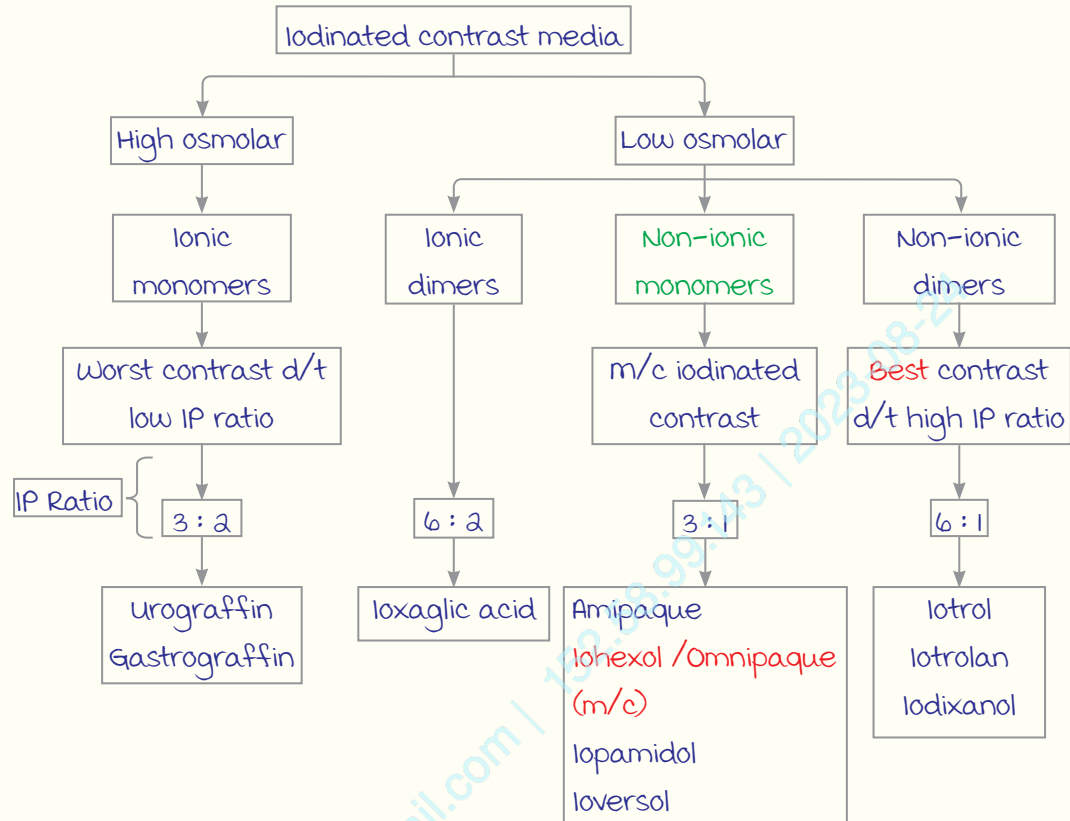
C/I of barium as a contrast media :

- Absolute : Perforation of organs → Severe chemical peritonitis/mediastinitis.
- Relative :
  - a. Hypersensitivity.
  - b. Suspected tracheo-esophageal fistula (TEF).
  - c. Vesicovaginal fistula (VVF).
  - d. Vesicorectal fistula.
  - e. Fecoliths.

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**Iodinated contrast :**

Classification of iodinated contrast :

**Contrast induced nephropathy (CIN) :**

markers of CIN :

- Serum creatinine : ↑ in serum creatinine by 25% from the pre-injection value or > 0.5 mg/dL within 48-72 h of contrast injection.
- Serum cystatin C.
- eGFR (< 60 mL/min).
- Neutrophil Gelatinase-Associated Lipocalin (NGAL) : Novel marker.

Risk factors of CIN :

- Increased age.
- Chronic HTN.
- Diabetes mellitus.
- Metabolic syndromes.
- Anemia.
- Hypovolemia.
- Dehydration.
- Multiple myeloma.
- Pre-existing chronic kidney disease : Single most important patient related risk factor.

management :

- Self limiting condition → Supportive treatment (Fluid and electrolytes).
- Very severe cases → Hemodialysis.

Prevention :

- Always perform **precontrast RFTs** before injecting contrast.
- Pre-hydrate the patient.
- N-acetyl cysteine therapy.
- Rosuvastatin, Vitamin C and bicarbonate therapy.

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MRI contrast agents :

01:20:50

|              | T1 relaxation agents | T2 relaxation agents  |
|--------------|----------------------|---|
| Example      | Gadolinium (m/c).    | Super paramagnetic iron oxide (SPIO).                               |
| MRI sequence | Bright on T1w.       | Dark on T2w.  |
| Comments     | c/i in pregnancy.    | used to detect ↑ Kupffer cell activity (Focal nodular hyperplasia). |

Hepatocyte specific contrast agents :

- Gd-manganese DPDP.
- mangafodipir trisodium.
- Gd-BOPTA.
- Gd-EOB-DTPA.

MRI contrast adverse effects :

- Nephrogenic systemic fibrosis (NSF).
- m/c seen in chronic kidney disease.
- Also caused by : Omniscan/Gadodiamide (Banned now).

# RADIOLOGY REVISION 2

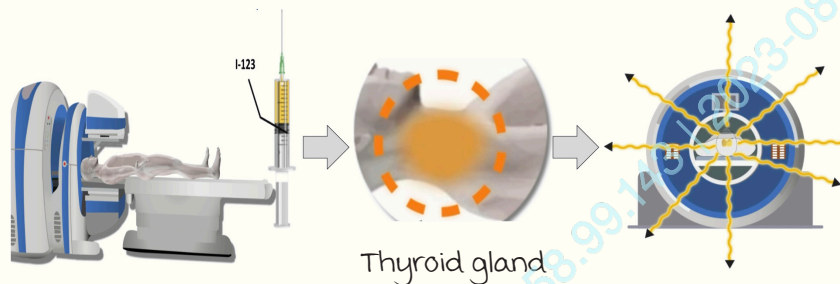
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## Nuclear Imaging

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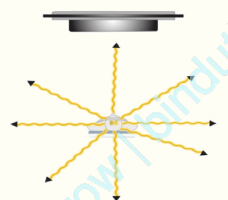
### Radionuclide scan :

A radio-nuclide is administered I/V → Emitted radiations are then detected with gamma cameras.

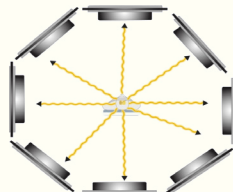


Depending upon the detection of radiation, they are classified into

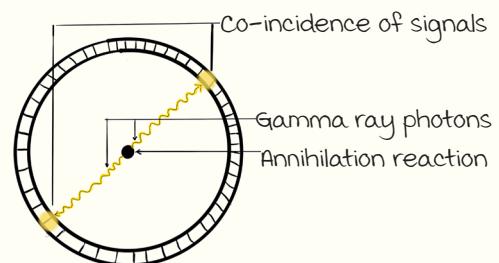
1. Planar scintigraphy : Single gamma camera from only one plane.
2. SPECT (Single Photon Emission Computed Tomography) :
  - Multiple gamma cameras from multiple planes.
  - Has better sensitivity.
  - Good anatomical and spatial resolution.



Planar scintigraphy



SPECT



Co-incidence imaging

3. PET (Positron Emission Tomography) :

- used for cancer imaging.
- m/c radio isotope used : 18-fluorodeoxyglucose (18-FDG).  
 GLUT type I is overexpressed in cancer cells → 18-FDG is phosphorylated & trapped in cancer cells (D/t Warburg effect → ↑ Glucose uptake).
- Co-incidence imaging : Positron (18-FDG) collides with electron (Normal tissue) → Annihilation → Release 2 gamma ray photons in opposite directions which coincide perfectly → Single point source of emission → Detected by ring of detectors.

Color coding of PET scans :

- High metabolic activity ( $\uparrow$  FDG uptake) : Red, yellow.
- Low metabolic activity ( $\downarrow$  FDG uptake) : Blue, green.

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Errors in PET scan :

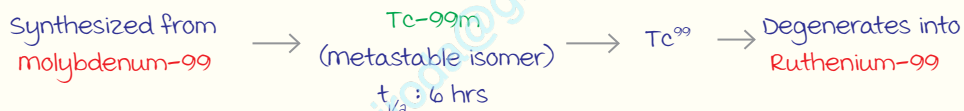
| False Negative   | False Positive  |
|--|---|
| <ol style="list-style-type: none"> <li>1. Tumor &lt; 1 cm.</li> <li>2. Low grade malignancies : <ul style="list-style-type: none"> <li>• Typical carcinoid.</li> <li>• Bronchoalveolar Carcinoma.</li> <li>• Lung metastasis from mucinous extrapulmonary tumour.</li> <li>• Tumours treated with chemotherapy.</li> </ul> </li> <li>3. Hyperglycemia (competition to uptake of FDG).</li> </ol> | Infection/Inflammation : <ul style="list-style-type: none"> <li>• Granulomatous conditions.</li> <li>• Cellulitis.</li> <li>• Abscess.</li> </ul> |

## Radioisotopes used in Various Nuclear Imaging

00:13:15

Technetium-99 :

m/c isotope used in nuclear medicine as it is easily adherent to any molecule/cell/particle.



Gallium-67 scan :

- $T_{1/2}$  : 78 hrs.
- Sensitive for detection of infection/inflammation (Pyrexia of unknown origin) but not specific (False positive seen in sarcoidosis & lymphoma).
- Leucocyte tagging increases specificity of Gallium-67.

Renal Imaging :

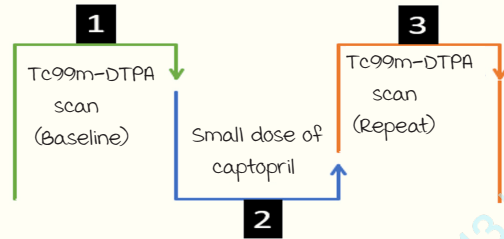
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1. Static (Structural / Anatomical evaluation) :
  - **Tc-99m DMSA** (Dimercapto Succinic Acid).
  - IOC in Cortical scars in vesico ureteric Reflux, Ectopic kidney.
2. GFR estimation : **Tc-DTPA** (excreted exclusively by glomerular filtration).
3. Dynamic/renal function evaluation :
  - Tc-mag3** (mercaptoacetyltriglycine)  $\rightarrow$  glomerular filtration & tubular secretion.

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## 4. Renal artery stenosis (RAS) :

- **Captopril Tc 99m-DTPA scan.**
- In RAS, Captopril causes efferent arteriolar dilatation  $\rightarrow$  Fall in GFR  $\rightarrow$  Renal failure.
- Captopril Tc 99m-DTPA scan is done before (Baseline : GFR<sub>b</sub>) and after (Repeat : GFR<sub>a</sub>) administration of a small dose of the Captopril.
- If  $GFR_a < GFR_b \rightarrow$  Renal artery stenosis.



## Cardiac Imaging :

00:24:45

## 1. Cardiac perfusion/Capillary blood flow Imaging :

- **Thallium 201** : Behaves like  $K^+$  & is more in intracellular space.
- Normal cardiac cells : Hotspot.
- Infarct : Cold spot (No perfusion).

## 2. Infarct imaging /Infarct Avid imaging :

- **99m Tc- Stannous pyrophosphate.**
- Infarct : Hot spot.

## 3. Radionuclide ventriculography :

- **MUGA scan** (Multiple Gated Acquisition scan) with **99m Tc- RBCs.**
- Cardiac function assessment : Stroke volume & cardiac output can be calculated through EDV & ESV.

## 4. myocardial Viability Assessment :

- Normal cardiac tissue : Source of energy is fatty acids (No uptake of FDG).
- Ischemic tissue : Source of energy is glucose.  
**18-FDG PET** will show increased uptake in ischemic tissue.

## Lung Imaging :

00:24:45

ventilation (V) - Perfusion (Q) scan :

- Was used for diagnosis of pulmonary embolism (Not used presently).
- Ventilation : **99mTc-Aerosols.**
- Perfusion : **99mTc-macroaggregated albumin.**

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- Normal  $V/Q = 1$ .
- Early Pulmonary embolism (PE) : Perfusion = ↓ or absent ; ventilation = Normal, V-Q scan → mismatched defect.
- In advanced PE (Lung infarction) : Triple match → Both V & Q ↓ and Chest X-Ray show consolidation.

### GI Tract Imaging :

00:31:46

- Radionuclide scan : High sensitivity.
- Threshold rate for detection of bleeding : 0.05 to 0.1 mL/min.

| 99m Tc Sulfur colloid    | 99m-Tc-RBCs                    | 99m-Tc-pertechnetate  |
|--------------------------|--------------------------------|---|
| Detects active GI bleed. | Detects intermittent GI bleed. | IOC for meckel's diverticulum (Has affinity for gastric mucosa) |

### Biliary Tract Imaging :

00:33:50

Hepatic Imino Di-Acetic Acid (HIDA) scan :

- I/V HIDA → Taken up by hepatocytes → Secreted into bile.
- Structures visualised : Right, left and common hepatic ducts; gall bladder (GB), cystic duct, common bile duct (CBD), duodenal opening of the CBD.
- Non visualisation of GB in HIDA : Acute cholecystitis.

### Skeletal Imaging :

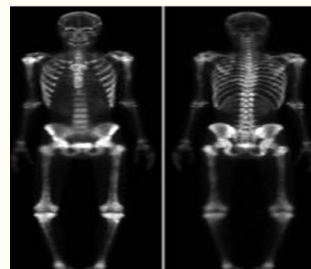
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99m Tc-MDP (methyl DiPhosphate) Bone scan :

MDP acts like bisphosphonate by binding to osteoclasts.

Super scan :

- Excessively high uptake of 99m Tc-MDP in the skeletal system.
- No uptake in soft tissue/kidney/bladder.
- Seen in hyperparathyroidism, renal failure, Paget's disease, metabolic bone disease.



Super scan



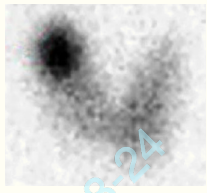
### Neck Imaging :

00:37:31

Thyroid Nodule imaging :

99mTc-pertechnetate/1-123 Na-iodide : used to image thyroid nodules.

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| Cold nodule   | Warm nodule   | Hot nodule  |
|---|---|---|
| No uptake of radionuclide in nodule.  | Uptake in nodule is similar to normal thyroid gland.                              | Uptake in nodule > normal thyroid gland.  |
| Highest malignant potential (20%).  | Intermediate risk of malignancy.  | Least malignant potential (2%).   |
|  |  |  |

Therapeutic uses of radioactive iodine :

- **Iodine-131** : Papillary thyroid cancer.
- **Iodine-125** : Brachytherapy (not commonly used).

Thyroid isotopes used in PET scan : **Iodine-124**.

Non-radioactive Iodine isotope : Iodine-127.

**Parathyroid imaging :**

**<sup>99m</sup>Tc-Sestamibi scan/<sup>99m</sup>Tc-Tetrofosmin scan :**

- IOC for parathyroid localisation : <sup>99m</sup>Tc -Sestamibi scan.
- IOC for parathyroid tumors : 4D CT (Axial + Coronal + Sagittal plane + Contrast enhanced).

**Salivary gland imaging:**

**<sup>99m</sup>Tc-pertechnetate scan :**

- Taken up by normal tissue & not taken up by tumour tissue.
- All tumors appear 'coldspot' except Warthin's tumor/Adenolymphoma of salivary gland (hotspot).

**Neuroendocrine (NET)/catecholamine producing tumor imaging**

**I-123 MIBG (meta-Iodo-Benzyl-Guanidine) scan :**

- used in Pheochromocytoma, medullary thyroid cancer, neuroblastoma, ganglioneuroma, ganglioneuroblastoma.
- NETs express somatostatin receptors (SSTR) → SSTR analogues are used for detecting NETs.

Note :

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- IOC for adrenal pheochromocytoma : **Contrast enhanced MRI.**
- IOC for extra-adrenal pheochromocytoma : **DOPA-PET Scan (Ga68-DOTATATE PET CT).**

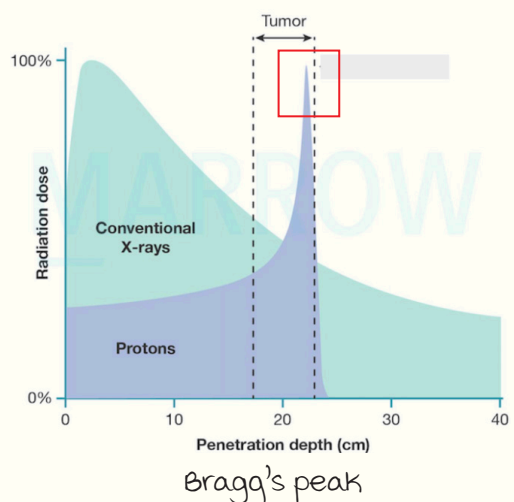
## Radiation Components

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|  |  |  |  |
|--|--|--|--|
| <p><b>ALPHA</b><br/>max. damage<br/>min. penetration</p>   | <p><b>BETA</b></p>   | <p><b>X-RAY</b><br/>m/c used</p>   | <p><b>GAMMA</b><br/>min. damage<br/>max. penetration</p> |
| <p>Ionizing/Damaging power decreases; Penetrating power increases →</p>  |  |  |  |
| <p>Intranuclear origin</p>   | <p>Intranuclear origin</p>   | <p>Extranuclear origin</p>   | <p>Intranuclear origin</p>                               |
| <p>Radium-223 :<br/>Rx of bone metastasis (mets)<br/>Radon-222 :<br/>• Contaminator<br/>• Causes lung cancer</p> | <p>Phosphorus-32 :<br/>Rx of :<br/>• Polycythemia rubra vera.<br/>• Bone mets.<br/>Strontium-89 :<br/>Rx of Bone mets (best isotope)<br/>Yttrium-90 :<br/>Trans-arterial chemoembolisation (TACE) of hepatocellular cancer</p> | <p>Technetium 99m :<br/>Diagnostic purpose.<br/>Cobalt-60 :<br/>Therapeutic purpose.</p> |  |

Bragg's peak :

- Entire energy is deposited (maximum dose delivery) at a single point.
- Seen in **heavy & charged particles** (α and protons).



## Radiotherapy

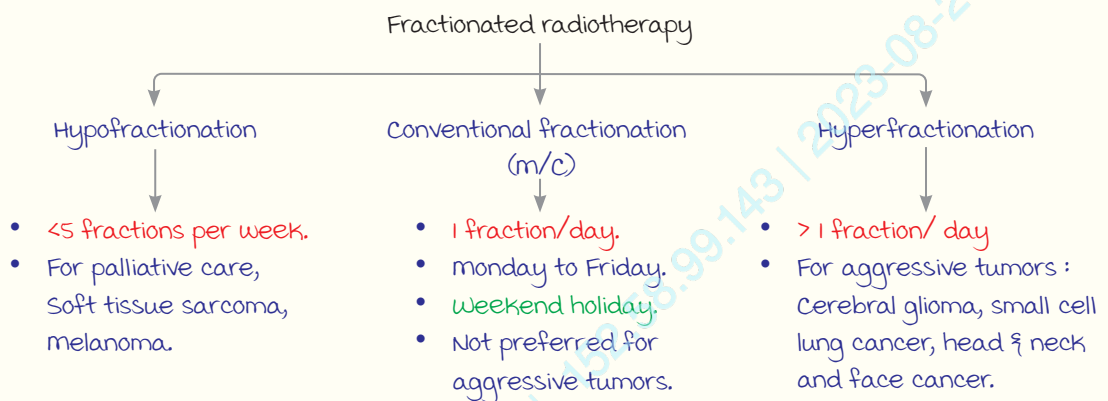
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### mechanisms of damage :

- Direct : Ionisation (First step) → dsDNA breaks → Cell death.
- Indirect (m/c) : Action on intracellular  $H_2O$  → Forming superoxide.

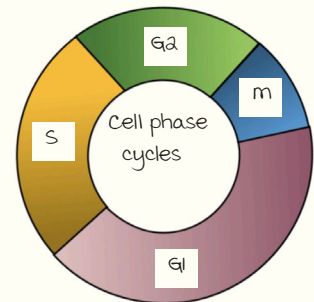
### Fractionated radiotherapy :

The total dose required is split into multiple fractions & then administered to pt.



### Radiotherapy - Cell sensitivity :

- maximum radiosensitivity is at the G<sub>2</sub>-M junction or at m phase.
- minimum radiosensitivity is at the S phase.



### Radio-sensitivity of tumors :

| Least sensitive (MOP)                        | most sensitive (WELMS)  |
|--|---|
| melanoma.<br>Osteosarcoma.<br>Pancreatic Ca. | Wilm's Tumor.<br>Ewing's sarcoma.<br>Lymphoma.<br>myeloma.<br>Seminoma. |

### The 5 R's of Radiotherapy:

- Radiosensitivity.
- Repair.
- Repopulation.
- Reoxygenation.
- Reassortment.

### Types of Radiotherapy :

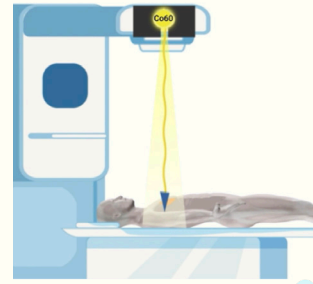
#### 1. External Beam Radiotherapy (EBRT)/Teletherapy (m/c) :

Radiation source is **at a distance** from the patient's body.

Two types :

##### a. Cobalt-60 machines :

- m/c used in past.
- $t_{1/2} = 5.2$  years.
- **Cobalt-60** : Artificial isotope.

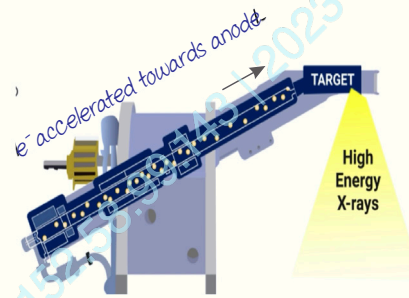


Cobalt-60 machine

Note : Naturally occurring Co isotope : Co-59 (non radioactive).

##### b. Linear Accelerators (LINAC) :

- High energy **X-rays** +  $e^-$  are produced.
- Easy to control and use.



LINAC

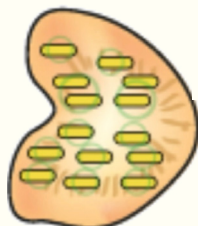
Disadvantage of EBRT: Normal tissue lying in the path of beam is exposed to radiation.

#### 2. Brachytherapy :

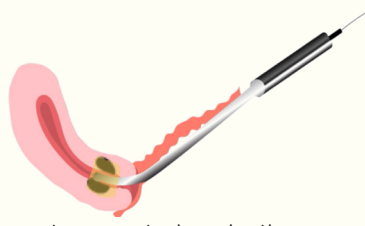
- Radiation source placed inside/on the tumor.
- It reduces the exposure to normal tissue.

Types :

| Brachytherapy type | Interstitial  | Intra-cavitary  | mould  | Systemic  |
|--------------------|---|---|--|---|
| Features           | Isotope placed inside tumour tissue.<br>under transrectal USG guidance and Remote afterloading. | Radiation source is placed inside a naturally occurring body cavity | Radiation source is placed on the surface of the body/tumor. | IV injection of an isotope which gets concentrated in the target organ. |
| Examples           | Ca prostate   | Ca cervix   | Ca penis, SCC of tip of finger.                              | Iodine-131 in papillary thyroid cancer.                                 |



Interstitial brachytherapy



Intra-cavity brachytherapy



mould brachytherapy

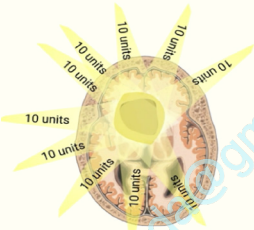
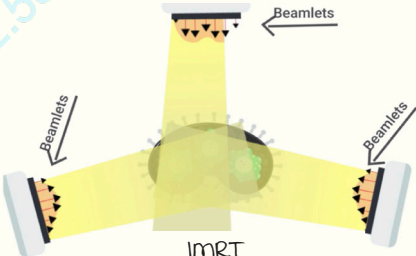
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## Special Applications of RT :

Intra-operative RT:

- Given during Surgical excision of tumors where approach is difficult.
- Intraoperative irradiation of tumour bed by **electron beam** (or) X-rays.
- E.g. : Ca. Pancreas.

Stereotactic radiosurgery and Intensity modulated radiotherapy

| Stereotactic radiosurgery/Gamma knife surgery   | Intensity modulated Radiotherapy (IMRT)   |
|---|---|
| <p>multiple beams (uniform strength) from <b>multiple directions are focussed on the tumour.</b></p> <p><b>Uses :</b> Brain tumours, vestibular schwannoma, pituitary adenoma, trigeminal neuralgia, metastasis &amp; AV malformations.</p>  <p>Stereotactic radiosurgery</p> | <p>Multi-directional beams with beamlets of different strengths that can be adjusted based on tumour dimension.</p> <p>Use : Ca prostate.</p>  <p>IMRT</p> |

Emergency radiotherapy :

Indications :

- Superior vena caval compression.
- Spinal cord compression.
- Pericardial neoplastic tamponade.
- Increased intracranial tension d/t metastasis.
- Hypercalcemia/tumor lysis syndrome.

Cranio-spinal irradiation :

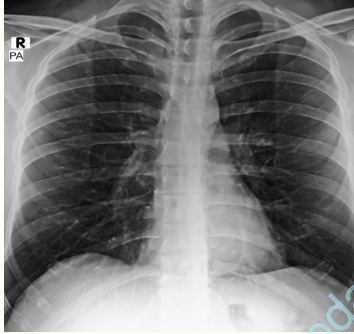
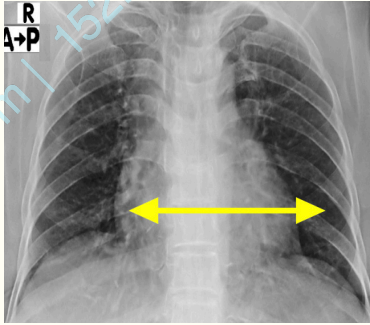
- Used to treat or prevent the spread of tumor.
- Indicated in **aggressive tumours** :
  - a. CNS : medulloblastoma, glioblastoma multiforme, germinoma.
  - b. Non-CNS : Acute Lymphoblastic Leukemia, Small cell lung cancer, Non-Hodgkin Lymphoma.

## RADIOLOGY REVISION 3

----- Active space -----

### CXR views

00:00:31

| Postero-anterior (PA) view  | Antero-posterior (AP) view   |
|---|--|
| m/c CXR view.   | Done in neonates/critically ill patients.  |
| Direction of x-ray beam : Posterior to anterior of the patient.   | Anterior to posterior of the patient.  |
| Tube to film distance : 6 feet/72 inches/180 cm.  | Tube to film distance : Less.  |
| X ray beam centered at inferior angle of scapula/T8 body/T7 spinous process.                              | Divergent X ray beam.  |
| Heart size : Normal<br> | False cardiomegaly is seen.<br> |

### Techniques of x-ray projection :

kvp (kilovoltage peak) is **inversely** proportional to image contrast.

kvp is **directly** proportional to penetrating power.

| Low kvp technique  | High kvp technique   |
|--|--|
| 60-80 kv.  | 120-170 kv.  |
| High contrast film.  | High penetrating x-ray beam.   |
| Use : <ul style="list-style-type: none"> <li>• military shadows.</li> <li>• Calcifications.</li> </ul> | Use : <ul style="list-style-type: none"> <li>• Obese patients.</li> <li>• To look for hidden areas.</li> </ul> |

### CXR Standard technique :

1. PA view.
2. Erect position (If unable : Sitting).
3. Suspended end inspiration.

----- Active space -----

Exceptions :

Indications of expiratory view :

- Pneumothorax.
- Foreign body aspiration (D/t air trapping).
- Obstructive lung disorders : Chronic bronchitis, emphysema.
- Diaphragmatic palsy.

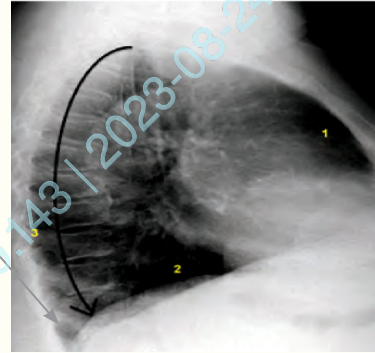
Other CXR views :

Lateral CXR view :

Normal findings :

- Posterior costophrenic recess :
  - a. most dependent part of pleural cavity.
  - b. Fluid collection in pleural effusion.

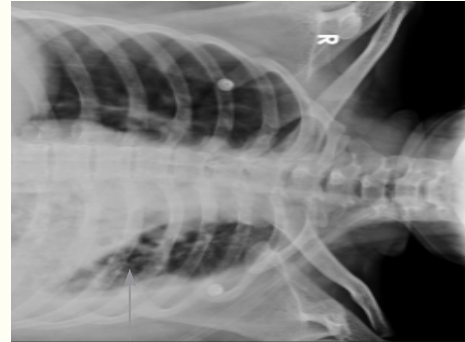
Costophrenic recess



CXR findings on lateral view

Lateral decubitus view :

- most sensitive radiograph for minimal pleural effusion : Left lateral decubitus view.
- IOC for minimal pleural effusion : USG.



Pleural effusion on left decubitus view

Posterior oblique view :

Right &amp; left.

To visualize :

- I/L rib fractures.

Lordotic view :

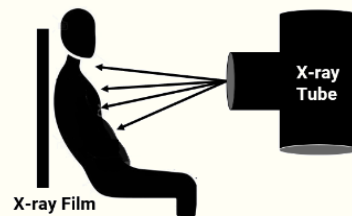
To visualize :

- middle lobe pathologies.

Apicogram :

To visualize :

- Lung apices.



Lordotic view/Apicogram

Note :

Conditions with **USG as IOC** (D/t fluid accumulation) :

- Pleural effusion.
- Pericardial effusion (Echocardiography).
- Ascites.


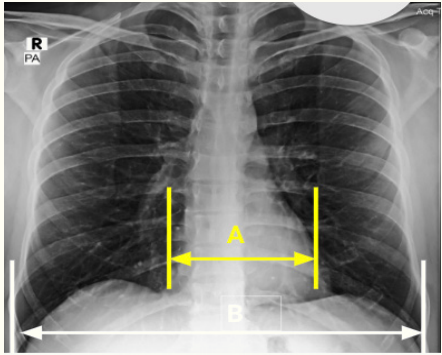
Conditions with **CT as IOC** (D/t air accumulation) :

- Pneumothorax.
- Pneumomediastinum.
- Pneumoperitoneum.
- Retroperitoneal organs (Pancreas).

----- Active space -----

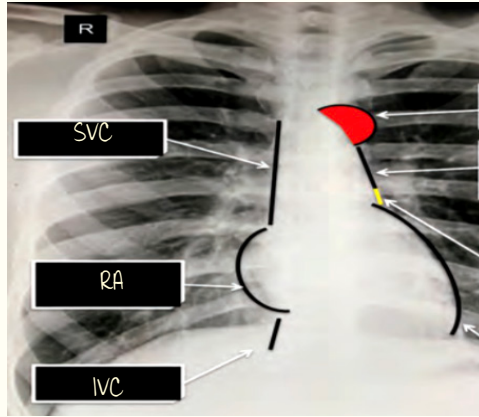
## Normal CXR interpretation

00:17:40

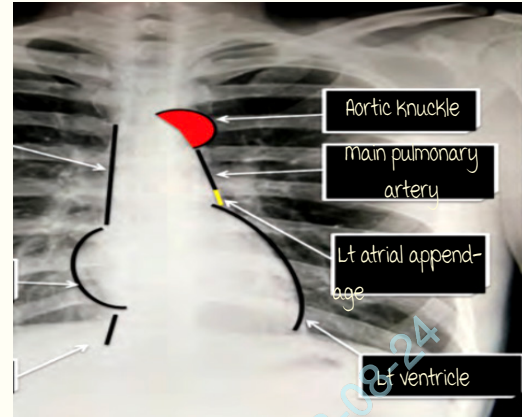
|  |   |
|--|---|
| <p>1. Identification of ribs :</p> <p>Location of ribs :</p> <ul style="list-style-type: none"> <li>• <b>Posterior ends</b> : Closer to midline.</li> <li>• <b>Anterior ends</b> : Away from midline.</li> </ul> <p>Orientation :</p> <ul style="list-style-type: none"> <li>• Posterior ends : Horizontal.</li> <li>• Anterior ends : Oblique.</li> </ul> <p>Criteria for X-ray taken in <b>adequate inspiration</b> :</p> <ul style="list-style-type: none"> <li>• <b>Posterior ends</b> : minimum <b>10</b> ribs visible above diaphragm.</li> <li>• <b>Anterior ends</b> : minimum <b>6</b> ribs seen above diaphragm.</li> </ul>  |  <p>Anterior end of rib (vertical)      Posterior end of rib (Horizontal)</p> <p>Adequate inspiratory radiograph</p> |
| <p>2. Cardiomegaly assessment :</p> <ul style="list-style-type: none"> <li>• Objective measurement : <b>Cardiothoracic ratio</b> :<br/> <math display="block">\frac{\text{max transverse diameter of heart (A)}}{\text{max transverse diameter of inner thorax (B)}}</math> </li> <li>• In PA view : <ul style="list-style-type: none"> <li>a. <math>&lt; 0.5</math> : Normal.</li> <li>b. <math>0.5-0.55</math> : Borderline.</li> <li>c. <math>&gt; 0.55</math> : Cardiomegaly.</li> </ul> </li> <li>• In AP view : <ul style="list-style-type: none"> <li>a. Normally : False cardiomegaly present.</li> <li>b. <math>&gt; 0.60</math> : Cardiomegaly.</li> </ul> </li> </ul> |  <p>Cardiothoracic ratio parameters</p>   |

----- Active space -----

3. mediastinal margins :

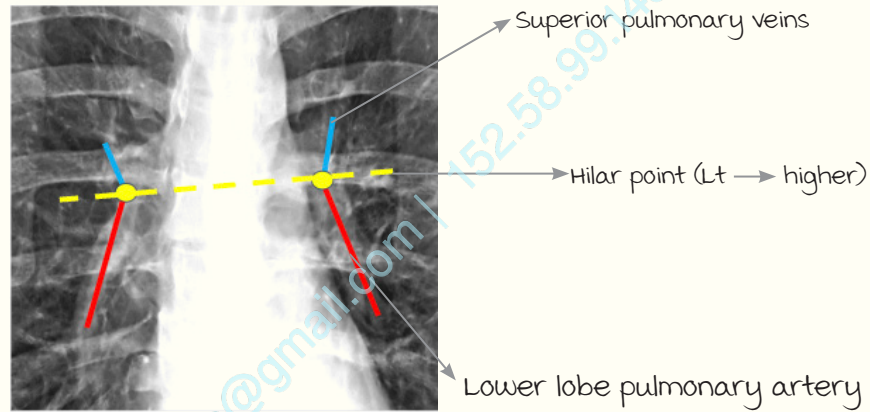


Right mediastinal margin

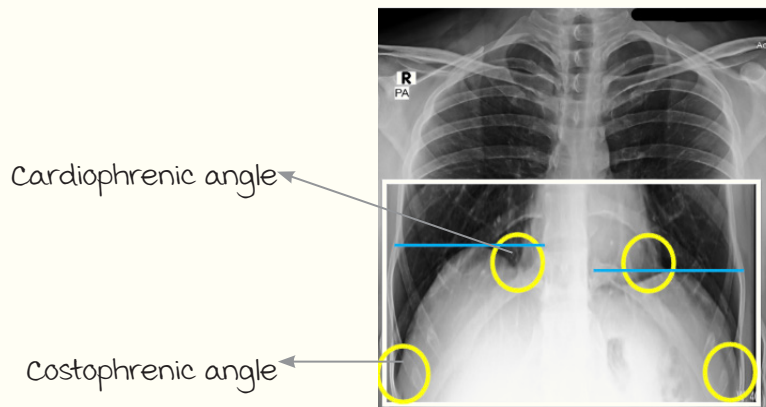


Left mediastinal margin

4. Hilum :

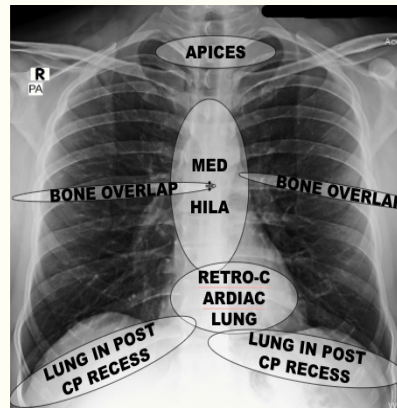


5. Diaphragm :



b. Hidden areas :

- Five hidden areas :
  - a. Lung apices.
  - b. mediastinum & hila.
  - c. Retrocardiac lung.
  - d. Lungs in posterior deep recesses.
  - e. Lungs overlapped by bones.
- Visualized by high Kvp CXR.

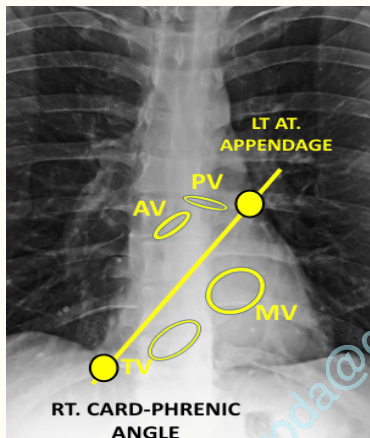


Hidden areas

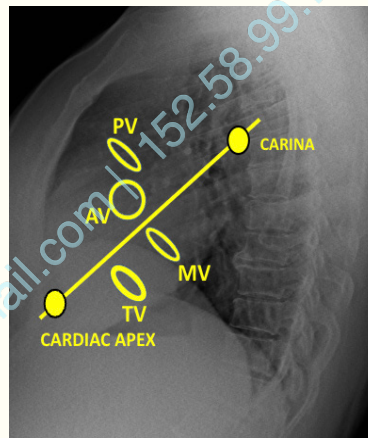
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### Prosthetic valves on CXR

00:37:33



PA view



Lateral view

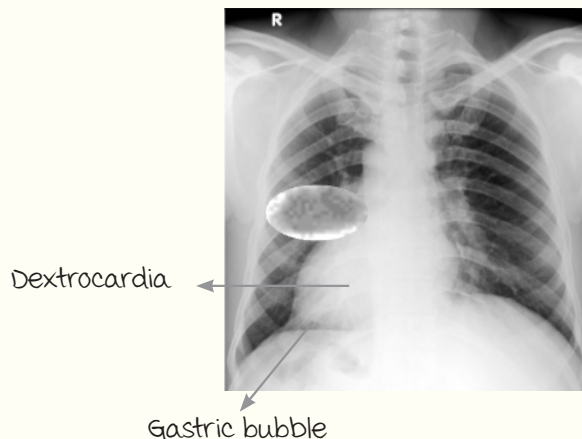
### Incidentals on CXR

00:40:26

I. Dextrocardia with situs inversus :

A/w Kartagener syndrome (Primary ciliary dyskinesia) :

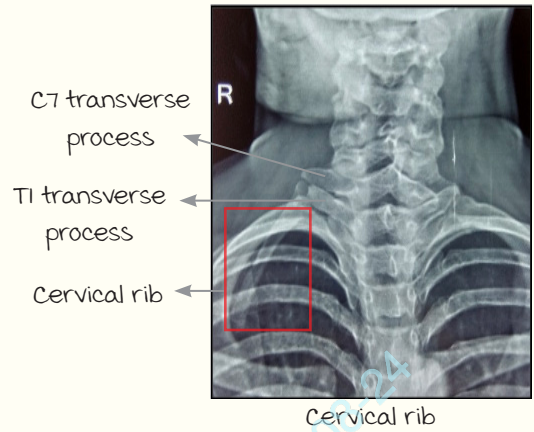
- Bronchiectasis.
- Sinusitis.
- Dextrocardia with situs inversus.
- Infertility.



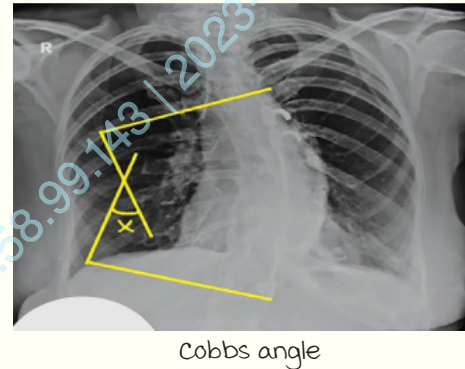
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**2. Cervical rib :**

- Extra rib articulating with the transverse process of a cervical vertebra.
- Asymmetrical.
- Significance : **Thoracic outlet syndrome.**

**3. Scoliosis :**

- Lateral curvature of spine.
- measured by **Cobbs angle.**
- Cobbs angle : Angle b/w the perpendiculars drawn to the lines from the cranial most and the caudal most scoliotic vertebra.

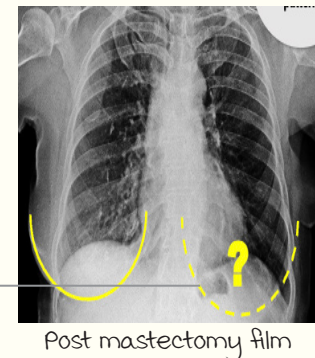
**4. Ca breast :**

Findings :

- Right breast shadow present.
- Left breast shadow missing : s/o post mastectomy.

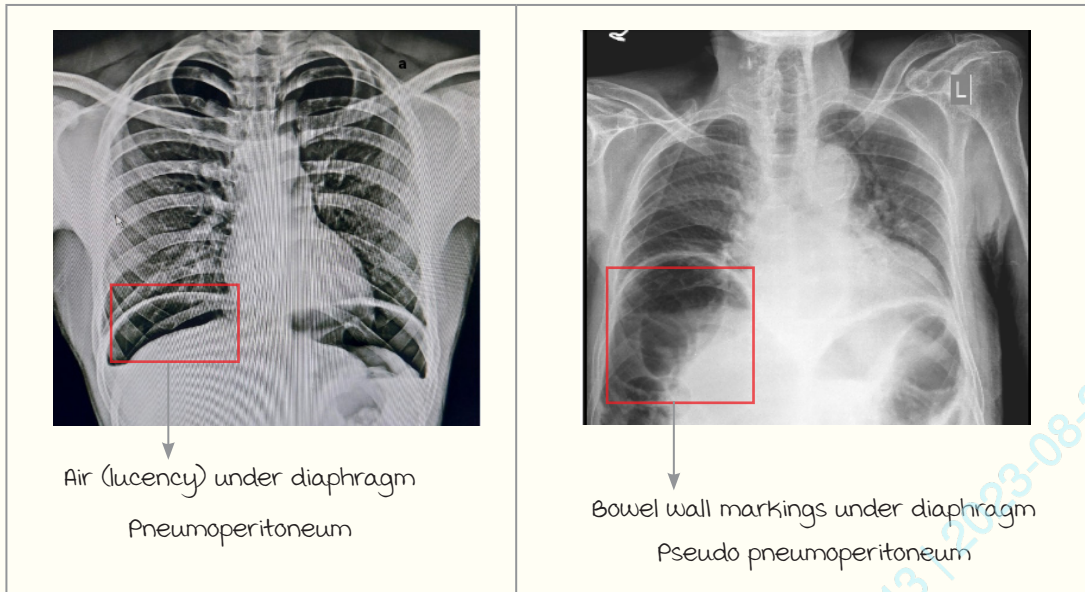
most likely points to Ca breast.

Absent left breast shadow



| 5. Pneumoperitneum  | 6. Pseudo pneumoperitoneum  |
|---|---|
| Clinical features : Abdominal pain & discomfort.  | Clinical features :<br>a. Asymptomatic with only x-ray findings : k/a <b>Chilaiditi sign.</b><br>b. Symptomatic : k/a <b>Chilaiditi syndrome.</b> |
| xray findings : <b>Lucency</b> (D/t free air) <b>below the dome of diaphragm.</b>       | xray : Lucency below the dome with bowel wall markings (Not free air).  |
| m/c cause : <b>Bowel perforation.</b><br>management : Emergency exploratory laparotomy. | Cause : Trapped transverse colon (hepatic flexure) b/w diaphragm & liver.   |

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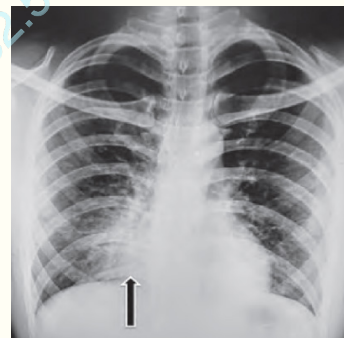


### Silhouette sign

00:47:33

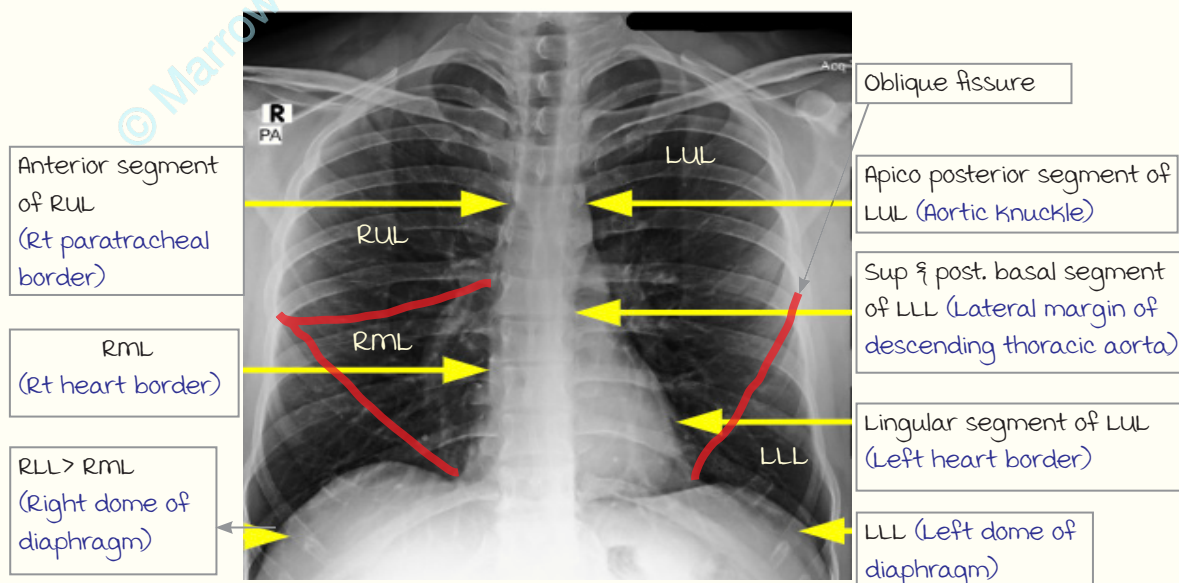
Positive silhouette sign :

Obscuration of sharp borders when the adjacent tissues are of similar densities.



Right heart border obscured (d/t RML consolidation) :  
Positive silhouette sign.

Normal cardiac silhouettes & lobar anatomy :



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## Air bronchogram sign

00:56:32

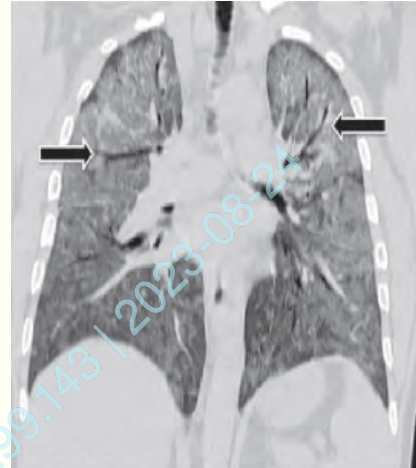
m/c associated with **infective consolidation** (Non specific).

Findings :

- **Opacity** in the lungs.
- **Black branching lines** through the opacity.

Other causes of air bronchogram :

- **Pulmonary edema.**
- **Interstitial lung disease.**
- **Bronchoalveolar ca.**
- **Pulmonary lymphoma.**
- **Pulmonary infarct.**
- **Pulmonary hemorrhage.**



# RADIOLOGY REVISION 4

----- Active space -----

## Clinical Scenarios

00:00:52

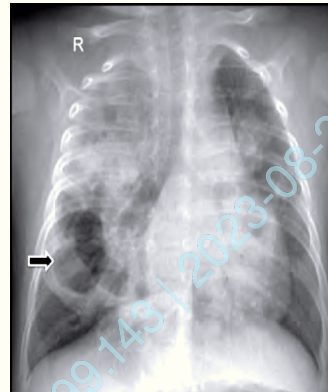
### Case 1 :

History : A child with fever, cough with expectoration, breathlessness, on Rx with antibiotics.

X-ray : Single/multiple air filled cystic lucency → pneumatoceles .

Diagnosis : **Staphylococcal pneumonia**.

Note : Community acquired pneumonia : m/c cause is streptococcus/pneumococcus (No pneumatocele).



Pneumatocele

### Case 2 :

History : **Chronic alcoholic/debilitated** patient with fever, cough with expectoration, breathlessness .

X-ray : Consolidation of right upper lobe with bulging of the horizontal fissure → **bulging fissure sign**.

Diagnosis : **Klebsiella pneumonia**.

Cavitation is also seen in K. pneumonia.



Bulging fissure sign

### Case 3 :

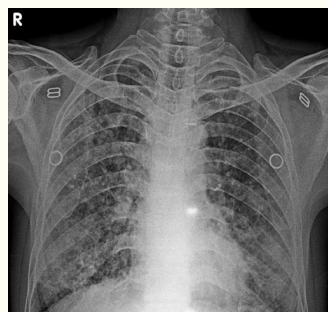
History : Atypical presentation.

- Less prominent signs of LRTI.
- more prominent constitutional** symptoms like headache, myalgia.

X ray : Atypical findings.

- Diffuse** interstitial thickening .
- Reticulonodular pattern** of consolidation .

Diagnosis : **Atypical pneumonia** ( m/c cause → mycoplasma pneumonia).



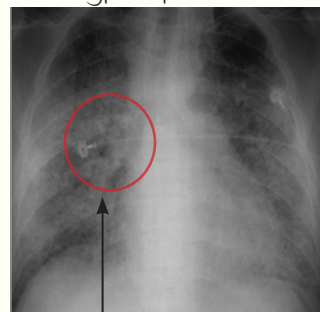
Atypical pneumonia

### Case 4 :

History : K/c/o HIV, CD 4 <200 cells/mm<sup>3</sup>.

Insidious onset dyspnea, non productive cough.

X ray : a. **Reticular interstitial opacities** (In central perihilar regions).



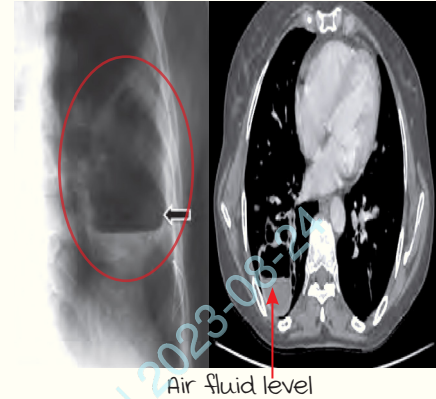
----- Active space -----

## b. Subpleural blebs/pneumatoceles.

HRCT : Central perihilar ground glass opacities.

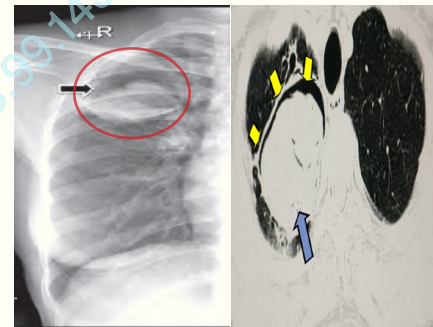
Diagnosis : *Pneumocystis carinii pneumonia.***Case 5 :**History : Chronic alcoholic, found unconscious.  
Later develops cough with expectoration, high grade fever.

X ray : Cavitory lesion in the lung with an air fluid level +/- consolidation.

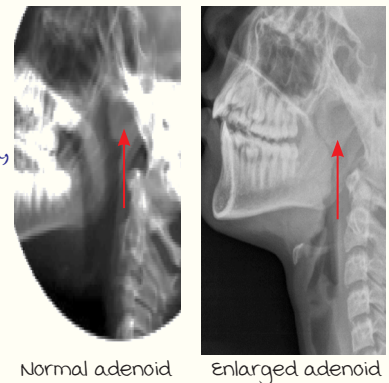
Diagnosis : *Lung abscess.***Case 6 :**History : Old case of TB with pre-existing cavity.  
Asymptomatic/occasional cough with hemoptysis.

On X- ray :

Lung cavity with mobile contents.

*Monad sign* : Air crescent present over content.Diagnosis : *Aspergilloma.*

Aspergilloma

Note : Air-crescent sign is descriptive of *invasive aspergillosis.***Case 7 :**History : A 8 year old child with persistent rhinorrhea,  
nasal congestion + 2 episodes of otitis media.Nasopharyngeal lateral radiograph : *Bulged soft tissue* with airway compromise.Diagnosis : *Adenoid enlargement.*

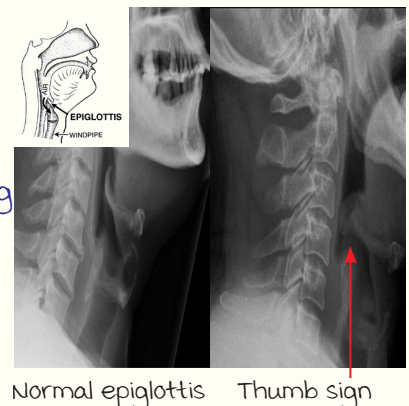
Normal adenoid

Enlarged adenoid

**Case 8 :**

History : A 4 year old child with recent H.Influenza infection.

C/F : Fever, change in voice with difficulty speaking &amp; inspiratory stridor.

Nasopharyngeal lateral radiograph : *Thumb sign* (Thickened epiglottis).Diagnosis : *Acute epiglottitis.*

Normal epiglottis

Thumb sign

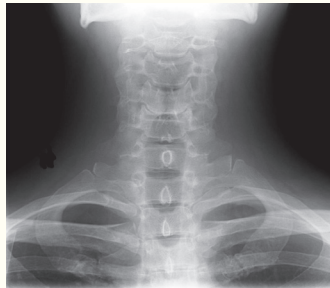
**Case 9 :**

History : A 3 year old child with protracted **barking cough**, **inspiratory stridor**.

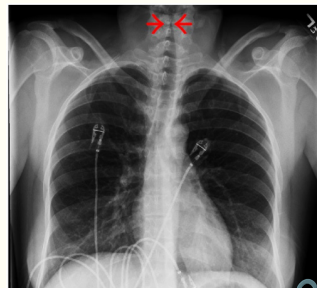
Neck AP radiograph : **Steeple sign/wine bottle sign** (Tapering & elongated subglottic airway).

Diagnosis : **Croup/acute laryngotracheobronchitis**.

----- Active space -----



Normal subglottic airway



Steeple/wine bottle sign

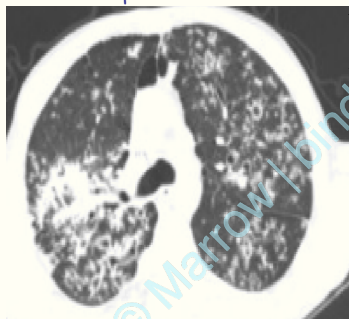
## Tuberculosis

00:13:10

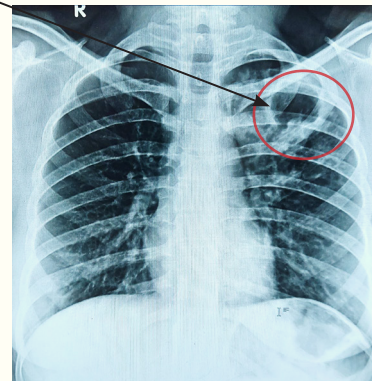
X-ray of post primary tuberculosis : **Apical cavitation (hallmark)** + **surrounding consolidation**.

Note : Cavitation is **never seen** in 1° TB.

HRCT : **Tree in bud appearance** (Endobronchial spread of TB).



Tree in bud opacities



Post 1° TB

### miliary nodules :

D/t **hematogenous spread** of TB disease.

1. multiple, tiny, discrete nodules of **1-3 mm** of size.
2. Diffusely scattered in both the lung fields.



----- Active space -----

Causes of miliary nodules :

| Cause          | Examples  |
|----------------|---|
| Infections     | <ul style="list-style-type: none"> <li>• Tuberculosis (m/c in India).</li> <li>• Healed varicella.</li> <li>• Blastomycosis.</li> <li>• Histoplasmosis.</li> <li>• Brucellosis.</li> <li>• Coccidiomycosis.</li> <li>• Cryptococcosis.</li> </ul> |
| Cardiac        | <ul style="list-style-type: none"> <li>• Chronic mitral stenosis.</li> <li>• Chronic pulmonary edema.</li> </ul>  |
| Neoplastic     | <ul style="list-style-type: none"> <li>• Lymphangitis carcinomatosa.</li> <li>• Metastasis.</li> <li>• Lymphomas.</li> <li>• Leukemias.</li> </ul>  |
| Pneumoconiosis | <ul style="list-style-type: none"> <li>• Silicosis.</li> <li>• Coal worker's pneumoconiosis.</li> </ul>   |
| Allergic       | <ul style="list-style-type: none"> <li>• Loeffler's syndrome.</li> </ul>  |
| Others         | <ul style="list-style-type: none"> <li>• Sarcoidosis.</li> <li>• Alveolar microlithiasis.</li> </ul>  |

Eponyms in TB :

| Eponyms             | Description  |
|---------------------|--|
| Ghon's focus/lesion | Pulmonary parenchymal evidence of 1° TB infection.         |
| Ghon's complex      | Ghon's focus + Lymphatics + Ipsilateral Hilar lymph nodes. |
| Ranke's complex     | Calcified Ghon's complex.                                  |

## COVID-19

00:19:48

IOC : RT-PCR .

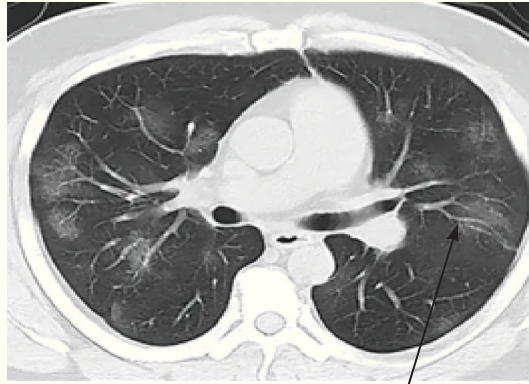
Imaging :

- 1<sup>st</sup> investigation : Chest X-ray.
- IOC for imaging : HRCT chest.
- Findings on HRCT :
  - a. Peripheral, multifocal, ground glass opacities (GGO)
  - b. Reverse halo/Atoll sign.

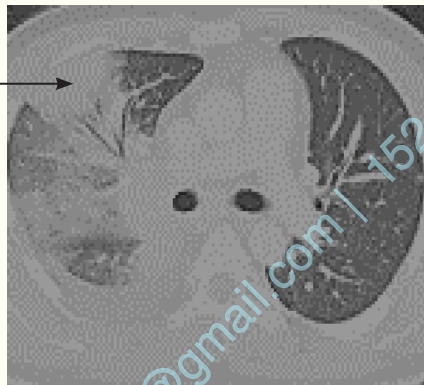
----- Active space -----



Normal lung on HRCT  
Deep grey with white lines & dots d/t the blood vessels.

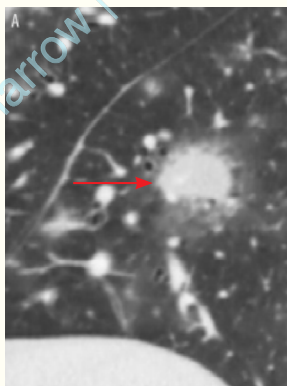


Ground glass opacity  
Hazy increase in density with visibility of blood vessels.

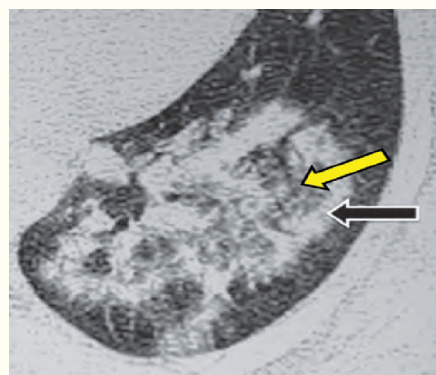


Consolidation :  
markedly increased density with obscured blood vessels with air bronchogram.

Note :



Halo sign :  
Central consolidation + peripheral halo of GGO (invasive fungal pneumonia).



Reverse halo/Atoll sign:  
Central GGO + peripheral rim of consolidation (Covid-19).

----- Active space -----

**CT involvement score :**

Assess extent &amp; severity of lung involvement.

| Assess the % of each lung lobe involved. |       | Scoring scale  |
|--|-------|--|
| Lung lobe                                | Score | <ul style="list-style-type: none"> <li>• No involvement : 0 (minimum).</li> <li>• &lt;5% : 1</li> <li>• 5-25% : 2</li> <li>• 25-50% : 3</li> <li>• 50-75% : 4</li> <li>• &gt;75% : 5 (maximum).</li> </ul> |
| Right upper lobe                         | 0-5   |  |
| Right middle lobe                        |       |  |
| Right lower lobe                         |       |  |
| Left upper lobe                          |       |  |
| Left lower lobe                          |       |  |
| Total score                              |       |  |

**CORADS (Covid-19 Reporting and Data System) :**

To predict the probability of covid-19 infection.

| Type     | Chance of infection | CT findings   |
|----------|---------------------|---|
| CORADS 1 | Highly unlikely     | Normal CT .   |
| CORADS 2 | unlikely            | Effusion/lymphadenopathy (Not seen in covid).       |
| CORADS 3 | Equivocal           | Single central GGO.                                 |
| CORADS 4 | Probable            | Few GGO.  |
| CORADS 5 | Highly likely       | Peripheral multifocal GGO.                          |
| CORADS 6 | 100%                | RT-PCR positive (Image findings are not considered) |

**Pleural Effusion**

00:28:30

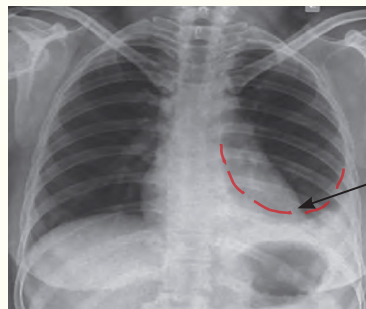
**X ray :**

Abnormal collection of fluid in the pleural cavity.

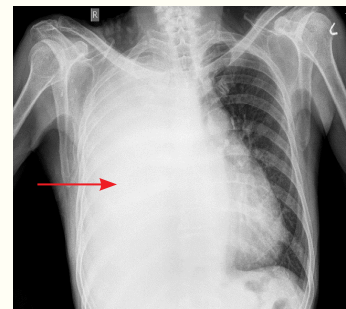
Typical X-ray findings :



Blunting of (CP) angle :  
 Earliest finding on CXR PA view.



Pleural meniscus sign :  
 Opacity with ill defined upper margins with concave meniscus facing upwards.



Opaque hemithorax :  
 Large effusion

1<sup>o</sup> investigation for opaque hemithorax : Chest X-ray.

IOC for opaque hemithorax : HRCT.

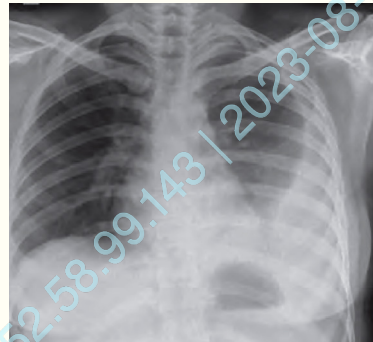
Differential diagnosis on CXR for opaque hemithorax :

| Differential diagnosis   | mediastinal shift     |
|--------------------------|-----------------------|
| massive pleural effusion | Push to opposite side |
| Collapse                 | Pull to same side     |
| Consolidation            | midline               |

Atypical imaging findings :

Lamellar pleural effusion :

Thick band/layer like appearance when the fluid rises vertically parallel to the lateral thoracic wall.



Lamellar PF

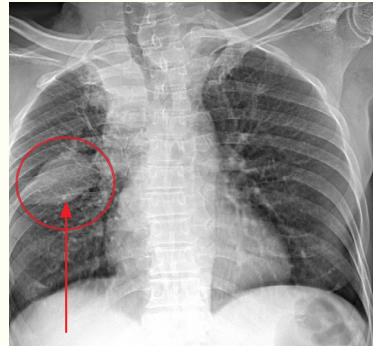
Clinical scenario :

Elderly male with dyspnea on exertion } s/o Congestive  
 O/E : Basal crepts, bipedal edema } heart failure

CXR :

1. mass like opacity in right middle zone.
2. Opacity disappears in 72 hours (k/a vanishing lung tumor/phantom lung tumor).

Diagnosis : Loculated pleural effusion in the horizontal fissure. Seen in Congestive heart failure.



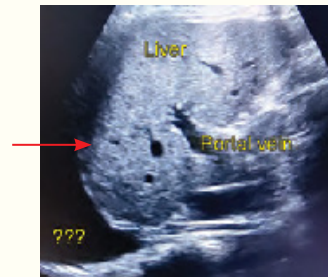
Loculated PF

Treatment : Inotropics & diuretics

USG :

IOC for pleural effusion.

Fluid appears anechoic/jet black in USG.

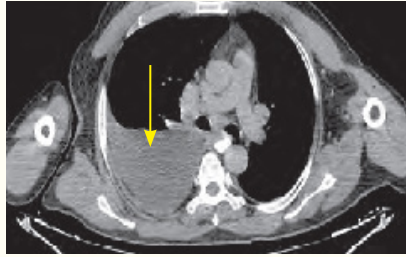


Jet black CP angle on USG in PF

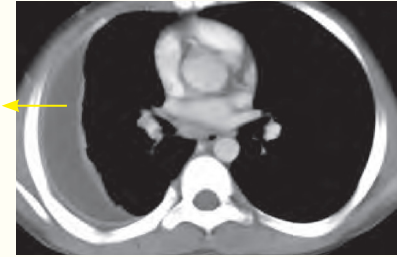
Pleural effusion vs Empyema :

| Pleural effusion           | Empyema   |
|----------------------------|---|
| Free fluid collection.     | Loculated collection of pus.                                |
| Settles in dependent part. | Settles in non dependent part.                              |
| No enhancement.            | Peripheral rim of enhancement, appears as split pleura sign |

----- Active space -----



Collection of fluid in dependent area (PF)



Split pleura sign in empyema.

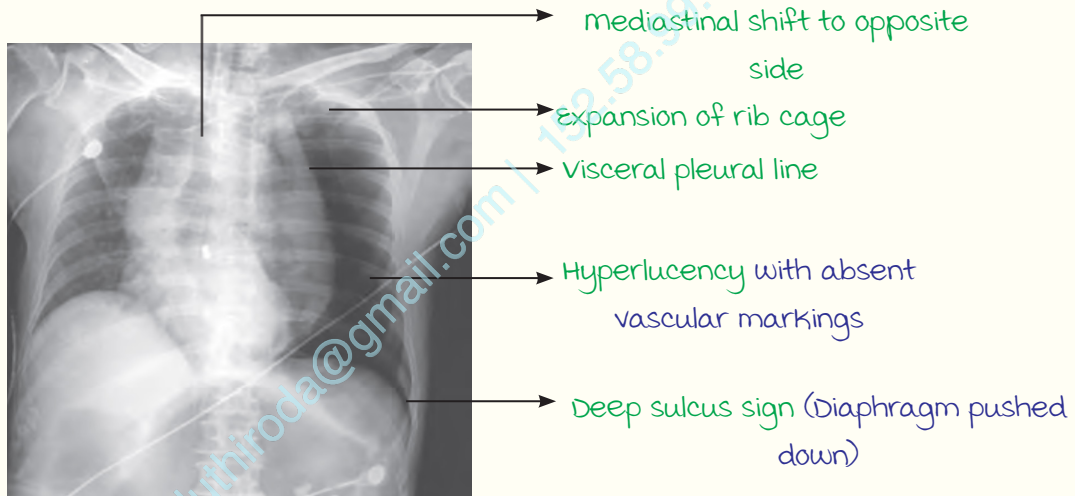
## Pneumothorax

00:39:00

Initial investigation : CXR-PA view in expiration.

IOC : CT chest (To detect minimal quantity of air).

Tension pneumothorax :



Treatment :

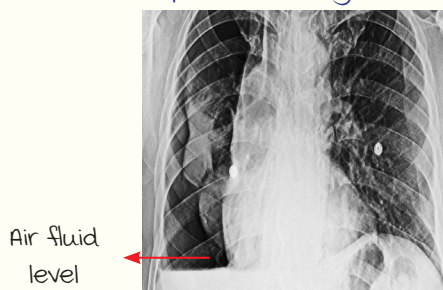
1<sup>st</sup> step : Needle thoracocentesis .

- Adults : 5<sup>th</sup> intercostal space in the mid-axillary line.
- Children : 2<sup>nd</sup> intercostal space in the mid-clavicular line.

2<sup>nd</sup> step : Intercostal drain insertion.

Hydropneumothorax :

Fluid + air in pleural cavity .



Air fluid level

On CXR

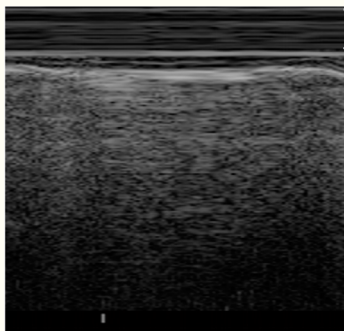
Air fluid level



On CT Chest

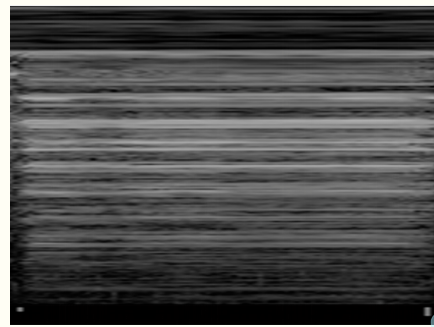
USG findings in pneumothorax :

----- Active space -----



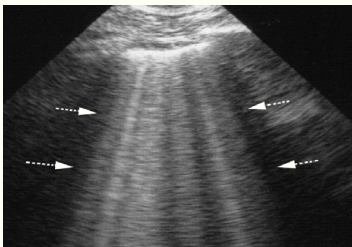
Waves d/t movement of the chest wall  
Sand : uniform & granular lungs

Normal USG thorax : Seashore sign.

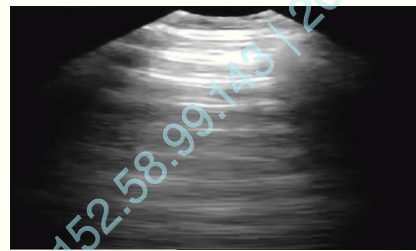


Pneumothorax : Stratosphere/barcode sign

On B-mode :



B lines : vertical (Normal)



A lines : Horizontal (Pneumothorax)

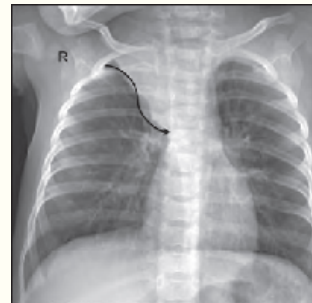
Other USG signs of pneumothorax :

- Absence of pleural sliding.
- Lung point identification sign.

Lobar Collapse

00:46:05

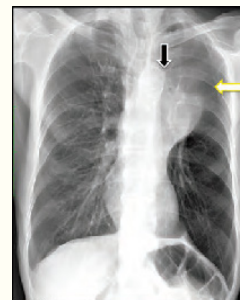
Right upper lobe (RUL) collapse → Golden S sign :  
Right upper lobe collapse + Centrally located mass lesion.  
Concavo-convex appearance of fissure.



Golden 'S' sign

Left upper lobe (LUL) collapse → Luftsichel sign :

- Curtain-like opacity along the left hemithorax.
- Left lower lobe (LLL) undergoes over-expansion.
- Superior segment of the LLL comes and lines the aortic knuckle creating a crescent.



Luftsichel sign (air crescent)

----- Active space -----

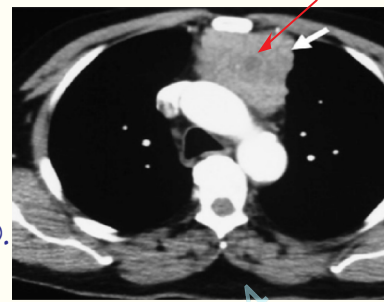
## Mediastinal Imaging

00:47:47

First investigation : CXR.

IOC : **C&T scan** (Exception : Posterior mediastinal masses).

IOC for posterior mediastinal mass lesions : **Contrast enhanced MRI** (To see extent of neurogenic tumors).



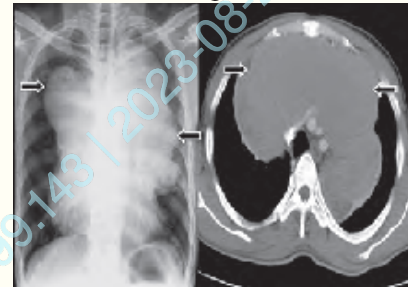
Thymoma

Thymoma :

- Overall m/c mediastinal mass lesion.
- m/c anterior mediastinal mass lesion.
- m/c thymic tumor .

middle mediastinal lesions :

- m/c : Lymphoma.
- m/c in children : Foregut duplication cysts.



middle mediastinal lesions

Posterior mediastinal lesions :

m/c : Neurogenic tumors.



Posterior mediastinal lesions

Neurenteric cyst :



Butterfly vertebra/hemivertebra/  
vertebral segmentation anomalies.

+



Posterior mediastinal mass lesion/  
cyst

**Pneumomediastinum :**

Air within mediastinum.

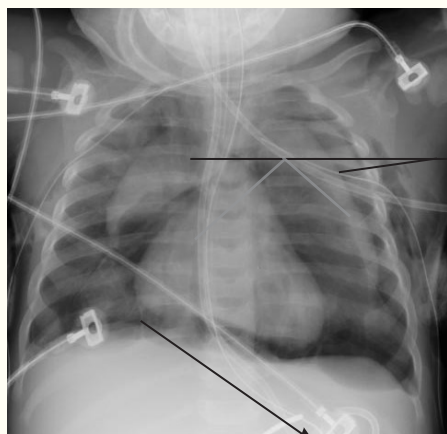
1<sup>st</sup> investigation : CXR.

Best/IOC : CT scan.

Signs on X-ray :

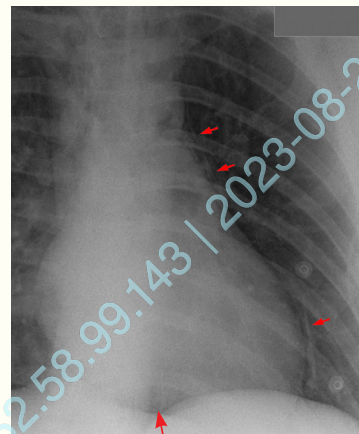
- **Spinnaker sail sign** : Thymus being outlined by air with each lobe displaced laterally & appearing like spinnaker sails.
- Continuous diaphragm sign.
- **Naclerio V sign** : V shaped lucency along the lateral margin of descending thoracic aorta & medial margin of left dome of diaphragm.

----- Active space -----



Continous diaphragm sign

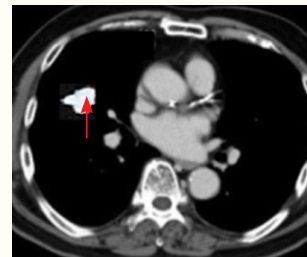
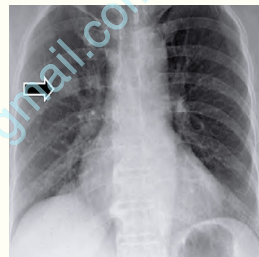
Spinnaker spail sign



Naclerio V sign

Solitary pulmonary nodule :

- Single nodule <3 cm in size (If >3 cms : mass → Biopsy) .
- 1<sup>st</sup> investigation : Chest X-ray.
- IOC : CECT > PET-CT.
- most of them are usually benign
- Coarse (popcorn) calcification : **Pulmonary hamartoma**



Popcorn calcification

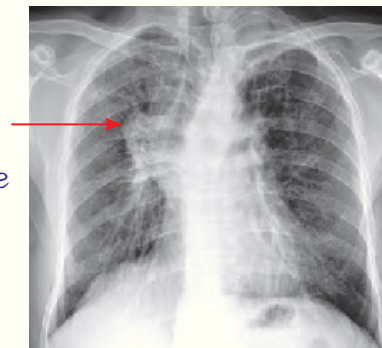
## Lung Tumors

00:54:47

1<sup>st</sup> investigation : CXR.

IOC : CECT (Exception : **Pancoast tumor**).

**Corona radiata appearance** : Spiculated appearance d/t invasion of tumor into the lung parenchyma.



Corona radiata

----- Active space -----

**Pancoast tumor :**

History : Elderly male, chronic smoker.

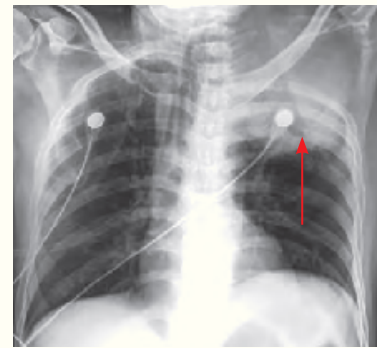
C/F :

- Cough + hemoptysis.
- Left sided **Horner's syndrome** : Cervical sympathetic ganglion invasion.
- Left upper limb : Pain, paresthesia & weakness (Brachial plexus invasion).

CXR : Apical mass lesion with destruction of ribs.

IOC : Contrast enhanced MRI

(To look for neural invasion).

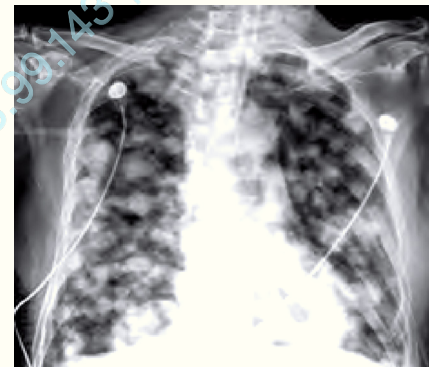


Pancoast tumor

**Cannon ball metastasis in lungs :**

D/d for cannon ball metastasis :

- Renal cell cancer (m/c origin).
- Choriocarcinoma.
- Germ cell carcinoma.
- Endometrial carcinoma.
- Prostate carcinoma.

**Other lung conditions**

00:58:45

**Bronchiectasis :**

C/F :

- Cough with expectoration.
- Intermittent hemoptysis.
- Recurrent chest infections.

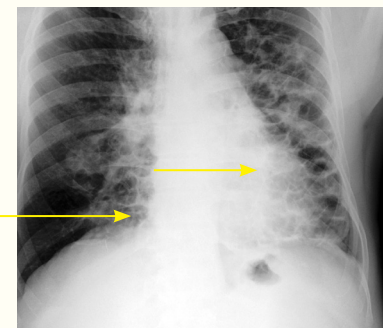
X-ray :

- 1<sup>st</sup> investigation.
- multiple thick walled cystic areas → Dilated bronchi.

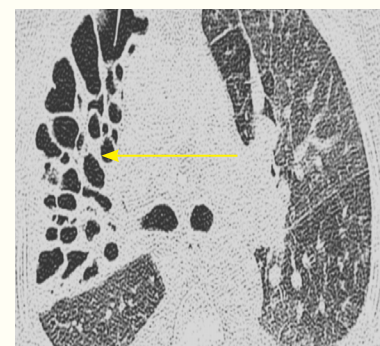
CT scan : IOC.

Signs :

- Cluster of grapes sign.
- Tram track sign.
- String of beads sign.
- Signet ring sign.



Dilated bronchi on CXR



HRCT

**Sarcoidosis :**

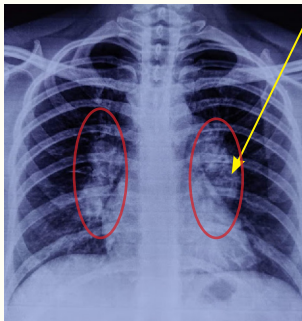
C/f : mild cough & weight loss.

Lab findings : ↑sed ACE levels.

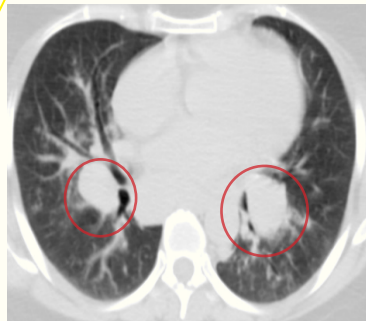
Imaging :

Chest x ray & CT chest shows :

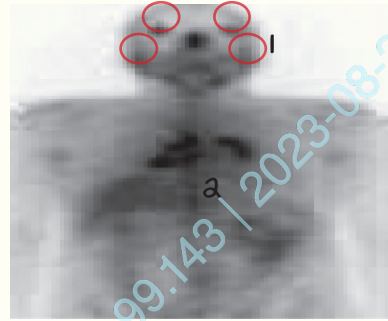
- Egg shell calcification of LN.
- Bilateral hilar & right paratracheal lymphadenopathy.



CXR



CT chest



Gallium scan :

1. Panda sign
2. Lambda sign.

Causes of egg shell calcification :

| SLAB of Calcium |   |
|-----------------|---|
| S               | Sarcoidosis, Silicosis, Scleroderma               |
| L               | Lymphoma (Post Rx)                                |
| A               | Amyloidosis                                       |
| B               | Blastomycosis, fungal infections (Histoplasmosis) |
| Calcium         | Coal worker's pneumoconiosis                      |

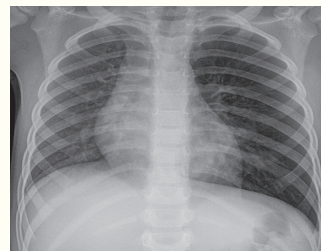
**Foreign body :**

History : A child with acute onset respiratory distress.

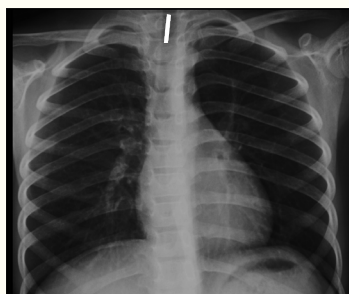
Diagnosis : Foreign body aspiration.

m/c aspirated foreign body : Peanut/groundnut (Not visualised on CXR).

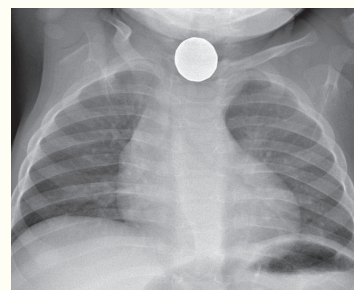
CXR : Air trapping in the affected lung.



Air trapping in lungs



Foreign body in trachea :  
Severe respiratory distress, inspiratory stridor,  
FB in sagittal plane.



Foreign body in esophagus :  
Less respiratory distress, dysphagia +nt ,  
FB in coronal plane

----- Active space -----

## Imaging in heart conditions

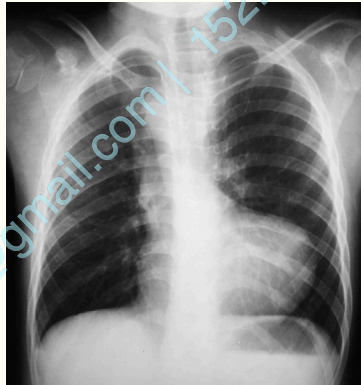
01:06:43

### Congenital heart anomalies :

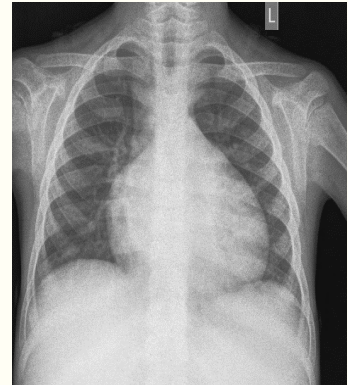
| Disease  | Apperance on x-ray   |
|--|--|
| Transposition of Great Arteries (TGA)                | Egg on side/egg on string appearance.                          |
| Tetralogy of Fallot                                  | Boot shaped heart/Coeur-en-sabot appearance.                   |
| Total Anomalous Pulmonary Venous Circulation (TAPVC) | Snowman/figure of 8 appearance.<br>(Specific for Type I TAPVC) |
| Ebstein's anomaly                                    | Box shaped heart.  |
| Partial Anomalous Pulmonary Venous Circulation       | Schimitar sign/turkish sword.                                  |



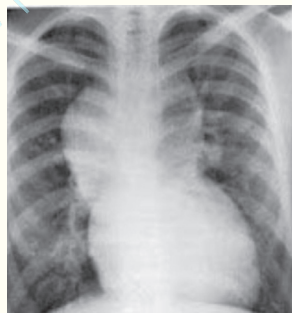
Egg on side/egg on string appearance.



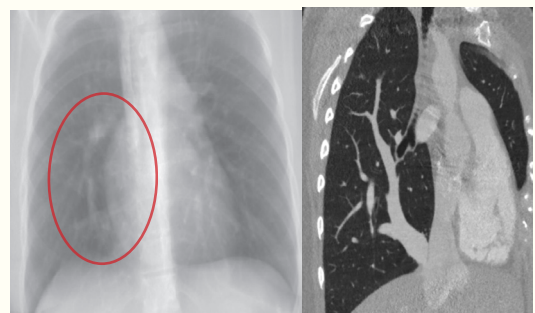
Boot shaped heart/Coeur-en-sabot appearance.



Box shaped heart



Snowman/figure of 8 appearance



Turkish sword/Schimitar sign

### Schimitar syndrome/Hypogenetic lung syndrome :

- Right lung hypoplasia.
- Hypoplastic right pulmonary artery with anomalous supply from aorta.
- Schimitar vein (Anomalous pulmonary vein drains into IVC)..

Coarctation of aorta :

m/c site : Distal to the site of origin of subclavian artery.

----- Active space -----

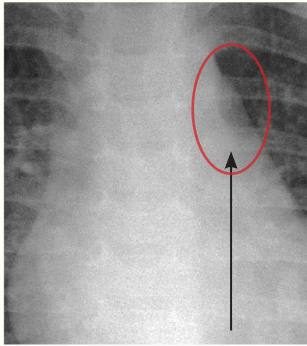
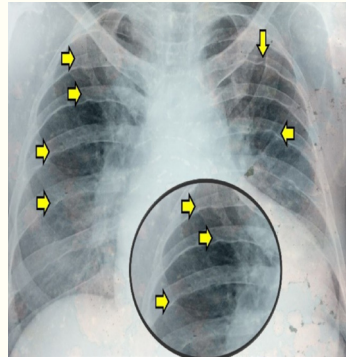
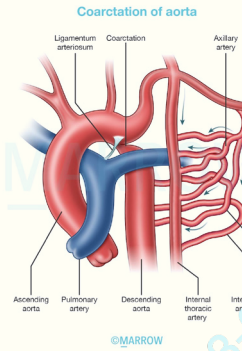


Figure of 3 sign : Dilated portions proximal and distal to the coarctation.



Inferior rib notching sign/Roesler's sign

- D/t the origin of collateral arteries from proximal dilated arteries.
- m/c arteries involved in collateral formation : **Internal mammary artery** & **intercostal arteries**.

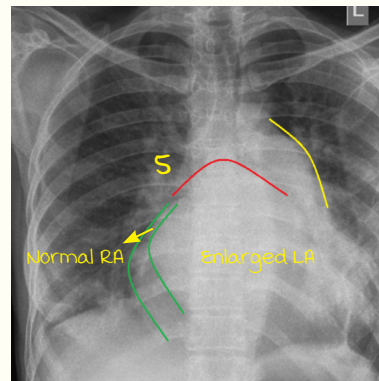
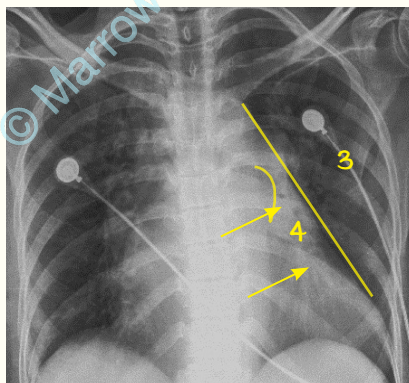


## Mitral Stenosis

01:10:50

Chest x-ray findings : D/t left atrial enlargement.

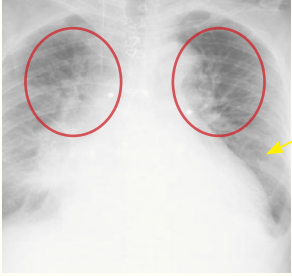
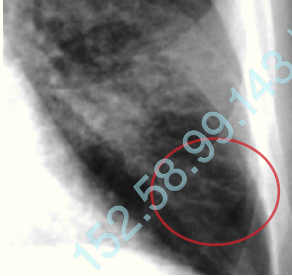
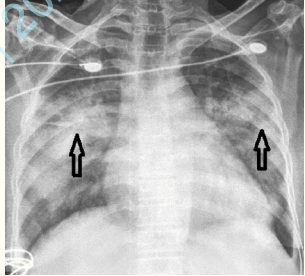
1. Fullness beneath the pulmonary artery shadow : Earliest finding.
2. Elevated left bronchus + splaying of carina  $>90^\circ$ .
3. Straightening of left heart border.
4. Third mogul sign : Prominences around atrium (Aorta + main pulmonary artery + left atrial appendage).
5. **Double density sign** : LA enlargement.
6. **Walking man sign** (Seen in lateral view) : Left bronchi pushed posteriorly.



----- Active space -----

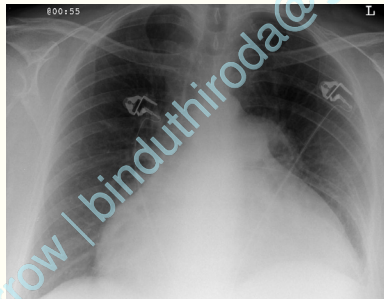
**Congestive heart failure :**

CXR staging :

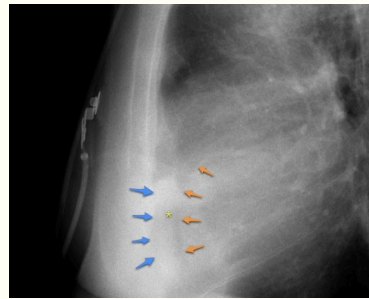
|             | Stage 1   | Stage 2   | Stage 3  |
|-------------|---|---|--|
| PCWP        | 13-18 mm of Hg  | 18-25 mm of Hg  | > 25 mm of Hg  |
| X-ray signs | <ul style="list-style-type: none"> <li>Cephalization of blood flow/stag antler sign/hands up sign/inverted moustache sign : Back pressure on superior pulmonary vein (upper lobe hilar vessels).</li> </ul> | <ul style="list-style-type: none"> <li>Interstitial edema.</li> <li>Kerley B line : Horizontal lines (D/t thickening of deep interlobular septae).</li> </ul> | <ul style="list-style-type: none"> <li>Alveolar edema.</li> <li>Bat-wing opacities (Central perihilar opacities).</li> </ul> |
|             |    |   |   |

**Pericardial effusion :**

IOC : Echocardiography.



money bag/flask shaped/water bottle appearance on CXR.



Oreo cookie sign on lateral view : Effusion separates pericardial &amp; epicardial fat.

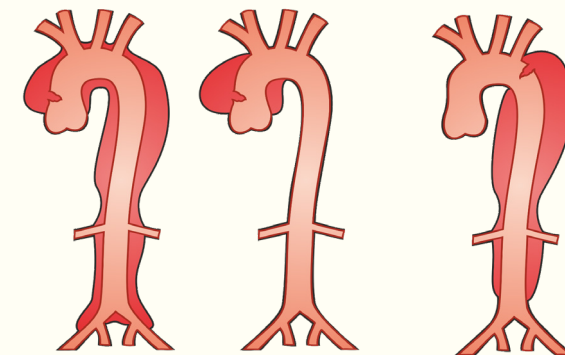
**Aortic dissection :**

Investigations :

- Emergency : Trans-esophageal echocardiography (TEE).
- IOC : CT Angiography (preferred)/MR Angiography.
- Gold standard technique : Invasive angiography.



Aortic dissection : Intimal flap divides lumen into false & true lumen



Stanford A  
DeBakey I

Stanford A  
DeBakey II

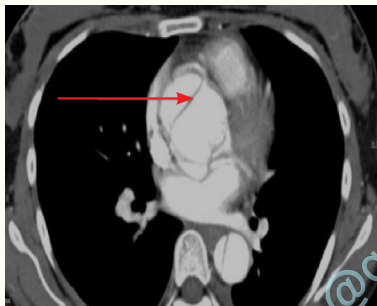
Stanford B :  
DeBakey III.

----- Active space -----

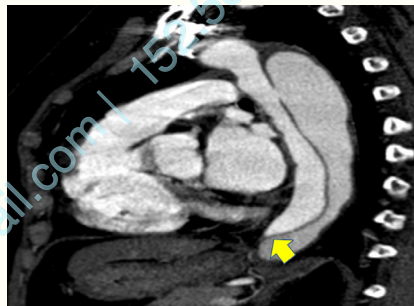
Classification of Aortic dissection :

1. DeBakey system.
2. Stanford system.

Signs :



Cobweb sign



Beak sign

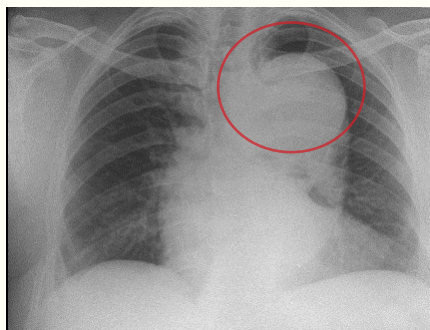
Aortic aneurysm :

Abnormal focal dilation aortic lumen.

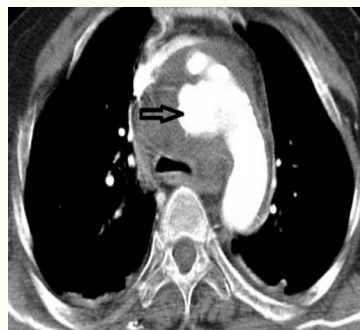
Absolute cut off :

- Ascending aorta >5 cm in diameter.
- Descending aorta >4 cm in diameter.
- Abdominal aorta >3 cm in diameter.

m/c site: Abdominal aorta (Infrarenal location).



X ray

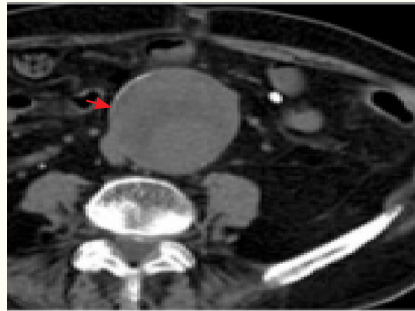


CT chest

----- Active space -----

Signs of impending rupture :

- Crescent sign.
- Draped aorta sign.



Crescent sign :  
Hyperdense blood clot



Draped aorta sign  
Aorta draped around  
vertebra

Note :  $\uparrow$  in aneurysm size  $>10$  mm/year is a sign of rupture.

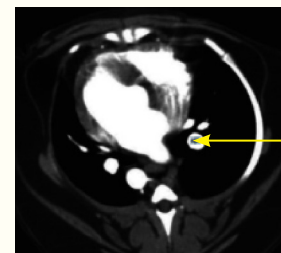
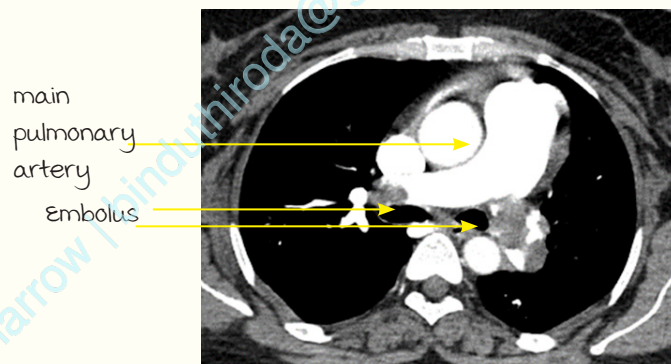
**Pulmonary embolism :**

C/F : Sudden onset breathlessness, cough and hemoptysis.

ECG : **SIQ3T3 pattern.**

CXR : Normal.

CECT : Clot inside the main pulmonary artery.



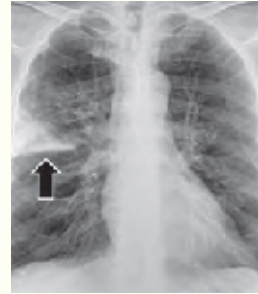
Polo mint sign : Central filling  
defect in artery.

Suspected pulmonary embolism :

- D-dimer test : **Screening test** (High negative predictive value).
- CT angiography : **IOC.**
- V/Q scan : Not used.
- Invasive pulmonary angiography : **Gold standard.**

Chest x-ray findings :

- Pulmonary signs :
  - a. Hampton's hump : wedge shaped pulmonary infarct.
  - b. melting ice cube sign : Pulmonary infarct resolution from periphery to center.
- Vascular signs :
  - a. Fleischner's sign : Enlarged right main pulmonary artery.
  - b. Palla's sign : Enlarged right descending pulmonary artery.
  - c. Chang's/Knuckle sign : Enlarged right descending pulmonary artery with an abrupt cut off.
- Westermark sign : Focal oligemia in lung fields.



Hampton's hump

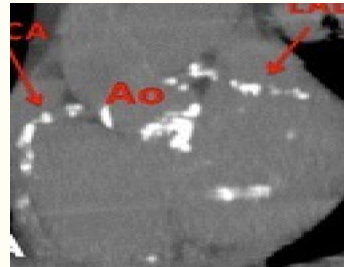
----- Active space -----

Agatston score :

- Semi quantitative method.
- Obtained from CT of the coronary arteries.
- Assesses the calcium burden on coronary arteries.
- $\text{Weighted density score} = \text{HU score} \times \text{Volume of calcification}$ .

Score :

- 101-400 : moderate.
- >400 : Poor prognosis.



# RADIOLOGY REVISION 5

## CT vs MRI

00:00:09

CT is done when time for diagnosis is **crucial**. E.g. Stroke, head trauma.

MRI is best image if there is **no time** constraints.

Indications for MRI :

- Brain tumor.
- Multiple sclerosis.
- Developmental delay.
- Demyelinating disorders.
- Convulsion 1 week back.

## Imaging in Stroke

00:02:23

1<sup>st</sup> investigation in acute stroke → **CT** (R/o hemorrhage).

Overall best/IOC for acute stroke : **DWI-MRI** (Detects infarct/ischemia).

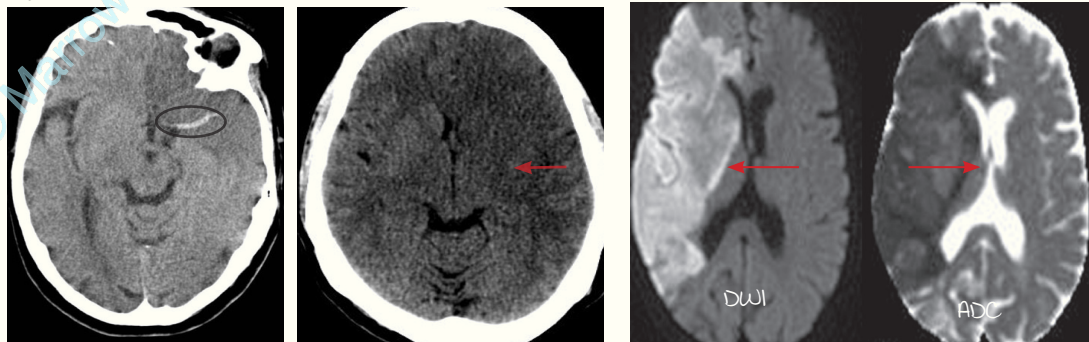
Penumbra in ischemia can be detected by **PWI-MRI** → Rx :Thrombolysis.

If hemorrhagic stroke detected on CT → mx of bleed.

IOC for vascular imaging in stroke : **CT Angiography/TOF** (Time of flight) **MR Angiography**.

**Ischemic stroke :**

Hyperacute stage : < 3-6 hrs.



(a)

(b)

On CT :

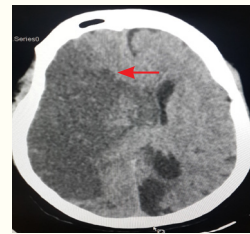
DWI with ADC map : Restricted diffusion.

- Hyper dense MCA (middle cerebral artery) sign.
- Disappearing basal ganglia sign (Lt side).

Acute stage :  $\geq 6$  hrs.

1. MCA territory infarct :

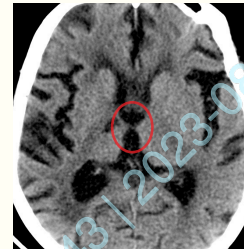
- Wedge shaped diffuse hypodensity (Oedema)
- Loss of grey-white differentiation.
- +ve cortical clinical signs : Aphasia, agnosia, etc.
- mass effect : Compression of ventricles and midline shift.



Acute right MCA territory infarct.

2. Lacunar infarcts :

- Involvement of basal ganglia or brainstem.
- Blockage of feeding artery  $\rightarrow$  Lacuna shaped.
- No cortical clinical sign.

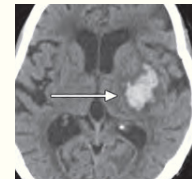


Acute right basal ganglia lacunar infarct.

Hemorrhagic stroke :

Acute hypertensive bleed :

Hyperdense bleed within basal ganglia + Rim of edema around.  
 m/c site of hypertensive bleed : Putamen  $>$  Thalamus  $>$  Pons.



Subarachnoid Hemorrhage :

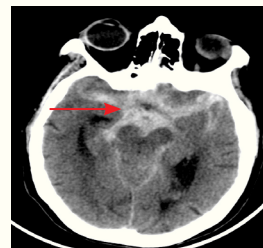
Clinical features : Thunderclap headache/worst headache.

$\downarrow$   
 Becomes unconscious.

CT finding : Hyperdensity (Blood) in basal cistern.

Pathology : Rupture of Berry aneurysm.

Poor prognosis.

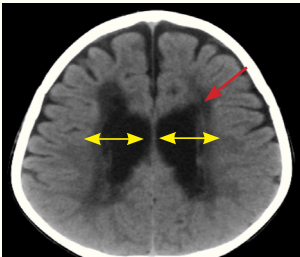
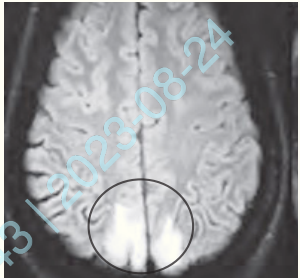
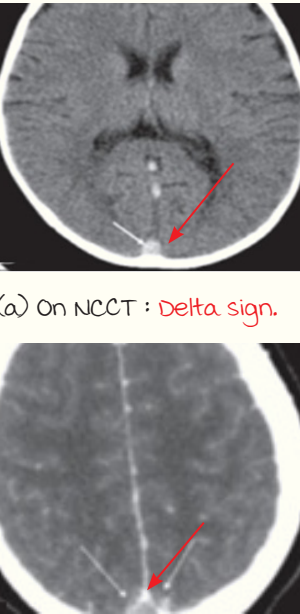
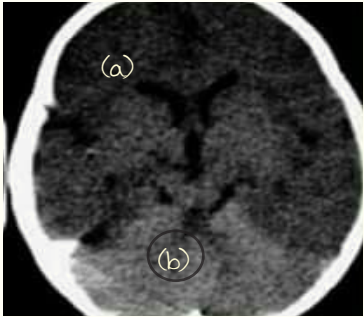



Other important conditions

00:15:28

| Condition   | Image |
|---|-------|
| <p>1. vein of Galen malformation :</p> <p>New born with high output CHF.</p> <p>Clinical features : Enlarged fontanelle, loud cranial bruit.</p> <p>CT finding : Dilated vein extending from straight sinus <math>\rightarrow</math> Confluence of sinuses.</p> |       |

----- Active space -----

| Condition   | Image  |
|---|--|
| <p><b>2. Periventricular leukomalacia :</b><br/>           Cause : Hypoxic ischemic encephalopathy (HIE) in preterm babies.<br/>           Clinical features : Seizures.<br/>           CT finding : Periventricular hypodense changes with ventricular dilatation.</p>   |   |
| <p><b>3. Posterior reversible encephalopathy syndrome (PRES) :</b><br/>           Cause : Severe pre-eclampsia.<br/>           MRI-FLAIR (Fluid attenuated inversion recovery) : Hyperintensities in the parieto-occipital lobe. Completely reversible.</p>   |   |
| <p><b>4. Venous sinus thrombosis :</b><br/>           Presents with severe persistent headache and vomiting.<br/>           Thrombosis of superior sagittal sinus : (a) and (b)<br/><br/>           Note : Thrombosis of transverse sinus shows Cord sign (NCCT).</p>   |  <p>(a) On NCCT : Delta sign.</p> <p>(b) On CECT : Empty delta sign. (Only walls of sinus enhanced).</p> |
| <p><b>5. Global cerebral hypoperfusion :</b><br/>           Following cardiac arrest/hypotension.<br/>           Indicates : Brain dead state.<br/>           Poor prognosis.<br/>           CT findings :</p> <ul style="list-style-type: none"> <li>a. Reversal sign.</li> <li>b. White cerebellum sign.</li> </ul> |   |

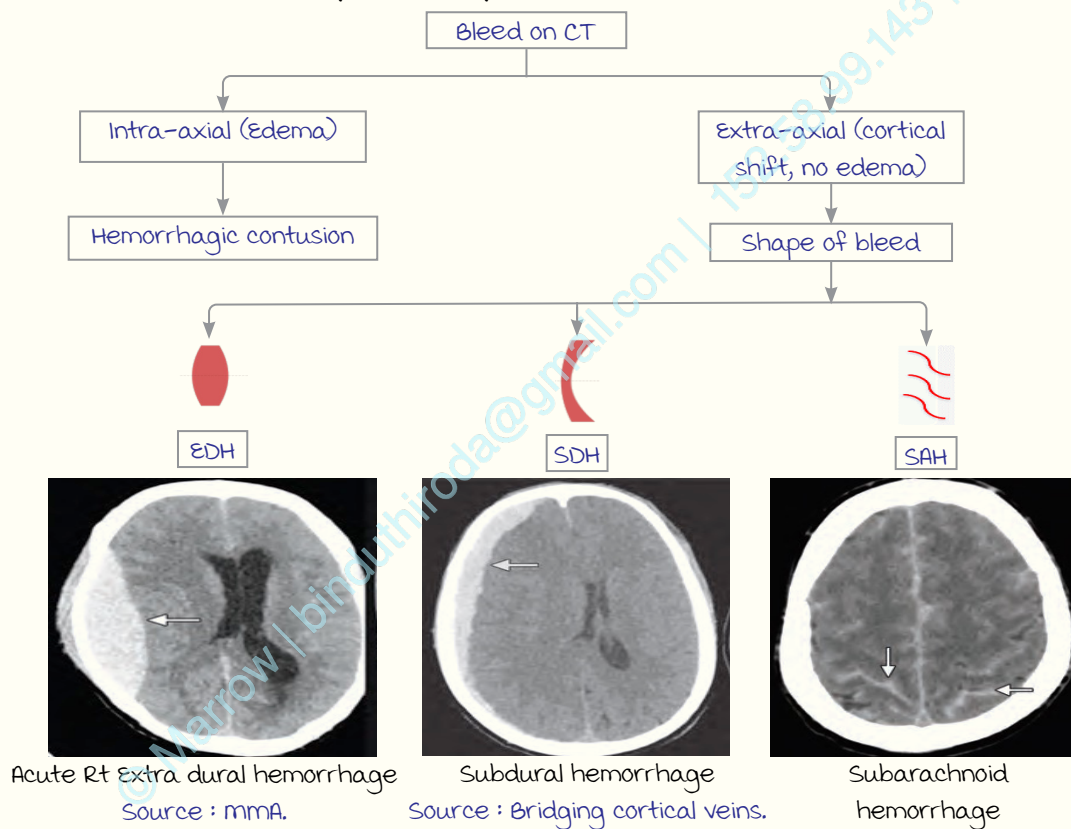
| Condition   | Image  |
|---|--|
| <p><b>6. Moya-moya disease :</b><br/>                     more common in children.<br/>                     Clinical feature : H/o multiple episodes of fainting, stroke.<br/>                     MRI brain + Angiography : Puff-of smoke appearance (Narrowed ICA → Large tuft of basal collateral arteries).</p> |  |

----- Active space -----

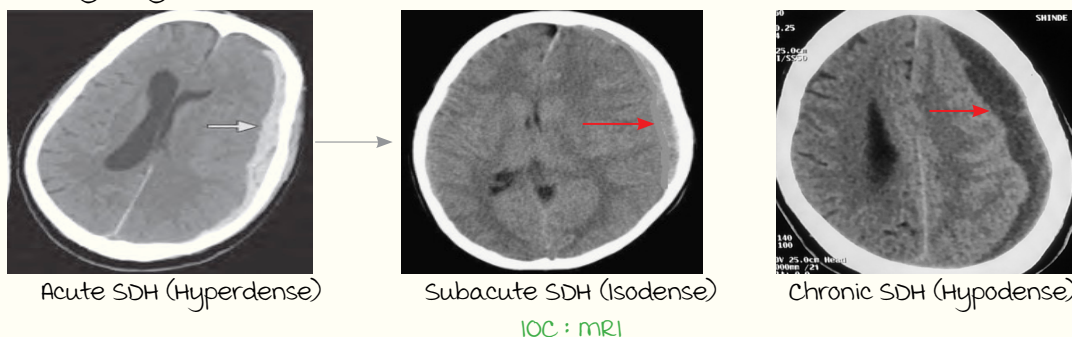
## CT in Head trauma

00:17:35

### Head trauma CT interpretation protocol :



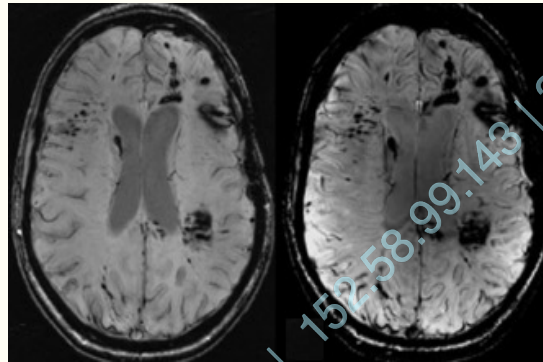
### Bleeding stages of SDH on CT :



----- Active space -----

**Diffuse axonal injury :**

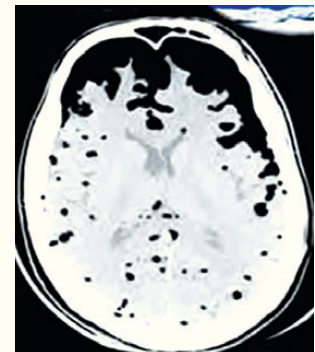
- H/o head trauma (E.g. RTA).
- Non-improving altered sensorium.
- Normal early CT brain.
- Pathology : Head trauma → Twisting force on neuron → Break at the junction of cell body and neurofilament of neurons diffusely → Petechial hemorrhages develop.
- MRI : GRE (Gradient echo)/SWI (Susceptibility weighted imaging) → Blooming (black spots) at grey-white matter junction/corpus callosum/brain stem.



Diffuse axonal injury

**Tension pneumocephalus :**

Fracture involving skull base of anterior cranial fossa (Involves PNS) → Air enters into intracranial space → Compress brain.

Tension pneumocephalus  
(mount fuji sign)**Brain tumours**

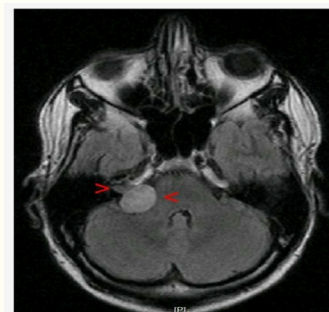
00:23:26

**Acoustic/vestibular schwannoma :**

mass at cerebello-pontine angle.

On CT : Ice cream on cone appearance.

If present B/L : Neurofibromatosis type II.



Acoustic/vestibular schwannoma

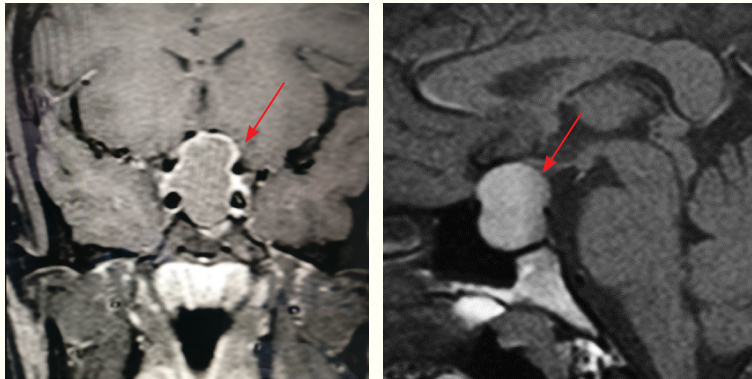
----- Active space -----

**Pituitary adenoma :**

Tumor in sella and supra-sellar area.

On CT : **Snowman/figure of 8 appearance.**

Types :



Pituitary macroadenoma : (> 10 mm).

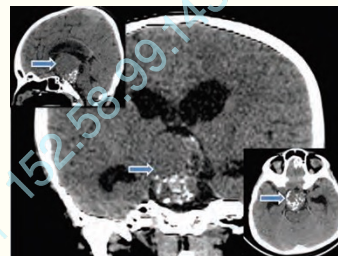
**Craniopharyngioma :**

Suprasellar mass lesion.

Cystic-solid lesion.

Calcification +ve.

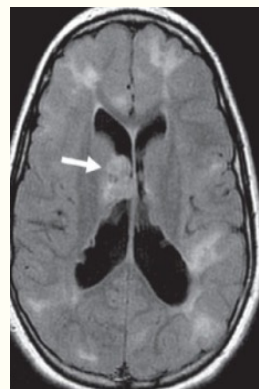
more common in children.



**Tuberous sclerosis :**

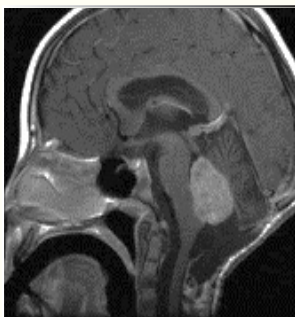


Subependymal nodules

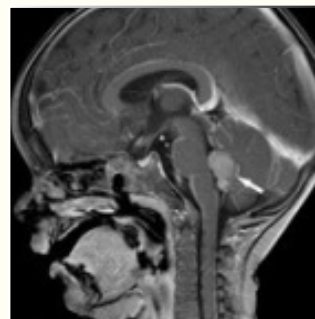


Subependymal giant cell astrocytoma

**Ependymoma vs medulloblastoma :**



Ependymoma :  
Lesion from **floor** of 4<sup>th</sup> ventricle.



medulloblastoma :  
Lesion from **roof** of 4<sup>th</sup> ventricle.

----- Active space -----

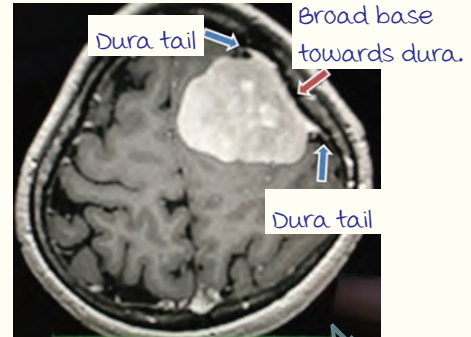
**Meningioma :**

Prototype extra-axial lesion.  
m/c primary non- glial tumor.

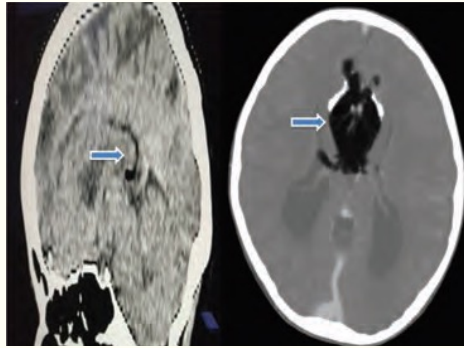
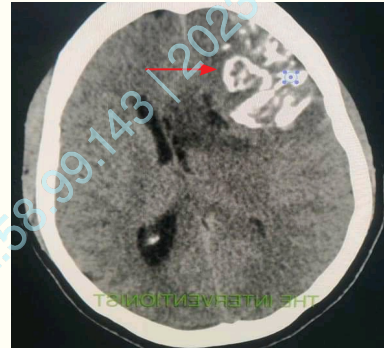
**Dural tails :** Pathognomonic.

Association : **MISME** syndrome (NF type II).

**M**ultiple **I**nherited **S**chwannoma,  
**m**eningioma,  
**E**pendymoma.



meningioma

**Corpus callosum lipoma****Oligodendroglioma**

Hypodense lesion with bracket shaped calcification. Cortical calcified tumor in middle age.

**Intra-axial tumors :**

|                     | Children        | Adults              |
|---------------------|-----------------|---------------------|
| Overall m/c         | Astrocytoma     | metastasis > Glioma |
| 2 <sup>nd</sup> m/c | medulloblastoma | -                   |
| 3 <sup>rd</sup> m/c | Ependymoma      | -                   |

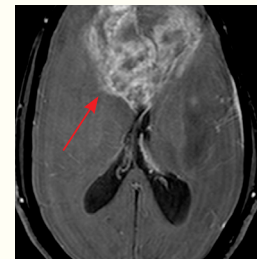
**Glioblastoma multiforme (GBM) :**

WHO grade IV tumor.

Aggressive : Spreads across corpus callosum to other side →

**Butterfly glioma.**

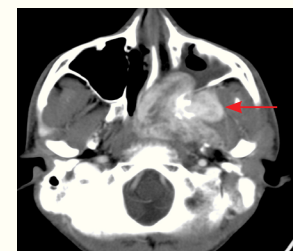
On CT : Thick irregular rim of peripheral enhancement & central necrotic area.

**Juvenile nasopharyngeal angiofibroma (JNAF) :**

Epistaxis in adolescent young males.

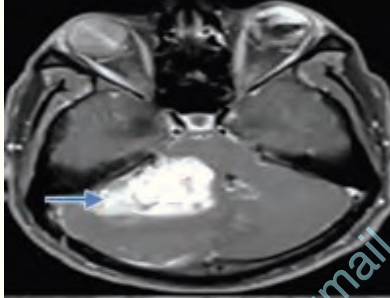
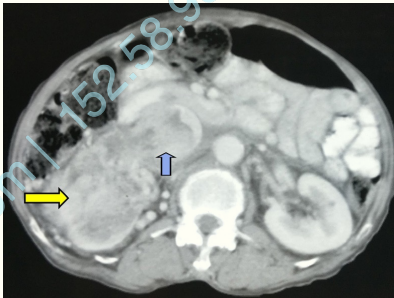
On CT : mass centered at sphenopalatine foramen.

On MRI : **Salt and pepper appearance.**



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## Syndromic association of tumors :

| Syndrome   | Tumors   |
|------------|--|
| NF type I  | Optic glioma, plexiform NF & brainstem glioma.   |
| NF type II | MISME syndrome   |
| VHL        | <p><b>HIPPLE :</b></p> <p>Hemangioblastoma of cerebellum.</p> <p>Increased risk of RCC.</p> <p>Pheocromocytoma.</p> <p>Pancreatic cysts/cancer.</p> <p>Epididymal pappillary cystadenoma.</p> <p>Liver cysts.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Cerebellar hemangioblastoma</p> </div> <div style="text-align: center;">  <p>RCC</p> </div> </div> |

## Infections of brain &amp; Multiple sclerosis

00:32:12

## Ring enhancing lesions :

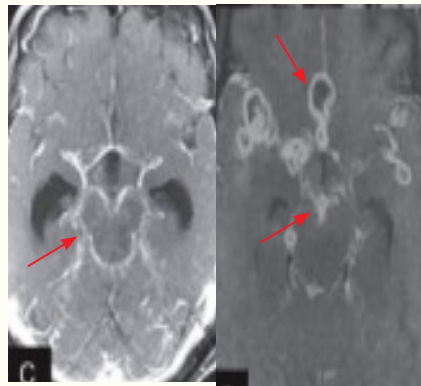
- Tuberculoma.
- NCC (Neurocysticercosis).
- Abscess.
- Toxoplasmosis.
- GBM.
- metastasis.
- Radiation necrosis.

## Tubercular meningitis :

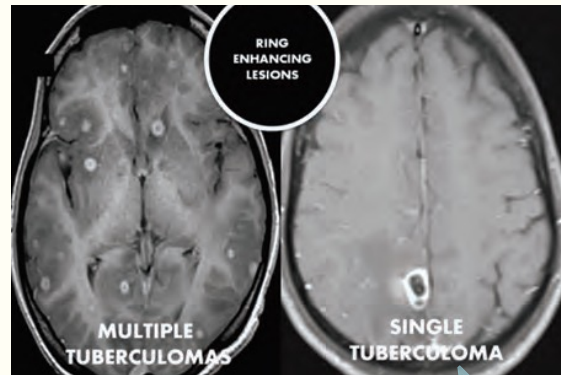
## Classical findings :

1. Basal enhancing exudates.
2. Hydrocephalus.
3. Tuberculoma.
4. Vasculitic basal ganglia infarcts.

----- Active space -----



Basal exudates



Disc and ring enhancing lesions

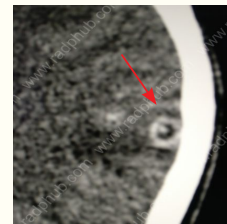
**Neurocysticercosis :**

Clinical features : Seizure and headache, no fever.

CECT : Cyst with a dot sign.

Escobar staging :

ventricular → Colloid vesicular → Granular nodular → Nodular calcified.

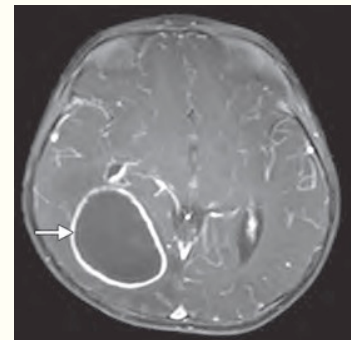
**Brain abscess :**

more common in young males.

In K/C/O unsafe CSOM.

Clinical features : Fever and altered sensorium.

CT : Ring enhancing lesion in temporal lobe.

**multiple sclerosis :**

more common in young females.

Clinical features : multiple neuro-deficits, cranial nerve palsies, remitting and recurring symptoms.

MRI- FLAIR : Dawson's fingers (Demyelinating plaques along white matter tracts).

MRI- FLAIR  
(Dawson's fingers)

## Imaging in Chronic alcoholics

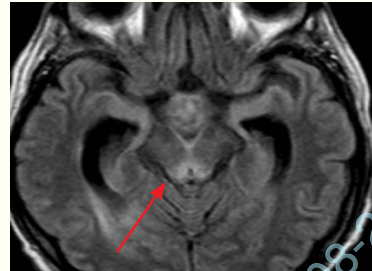
00:37:22

----- Active space -----

Wernicke encephalopathy/Wernicke Korsakoff syndrome :

H/O : Acute confusion, ataxia, ophthalmoplegia.

Imaging : Hyperintensity/ involvement of  
mammillary body.



marchiafava bignami disease :

Non specific clinical findings : motor/cognitive disturbances, seizures, apraxia.

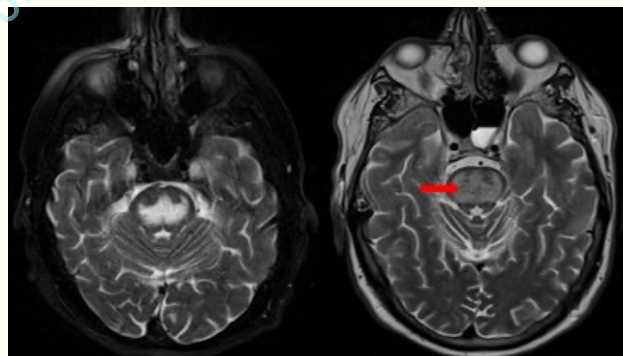
On imaging : Hyperintense lesion in corpus callosum (Splenum).



Central pontine myelinolysis :

Rapid correction of hyponatremia → Transiently improves, then deteriorates.

Imaging : Hyperintensity in central fibers of pons.



# RADIOLOGY REVISION 6

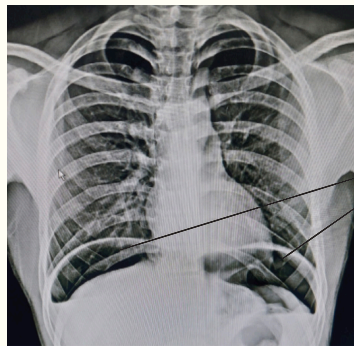
----- Active space -----

## GIT system

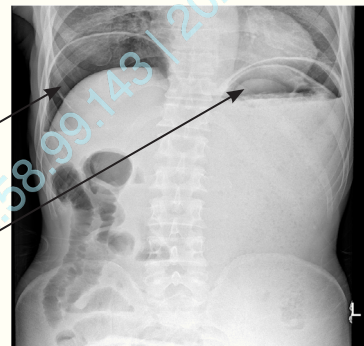
00:00:37

### Pneumoperitoneum :

- X-ray : Air under the diaphragm.
- Best : CXR erect.
- m/c done : Abdominal x-ray erect.
- m/c cause in adults : Perforation of bowel.



CXR erect

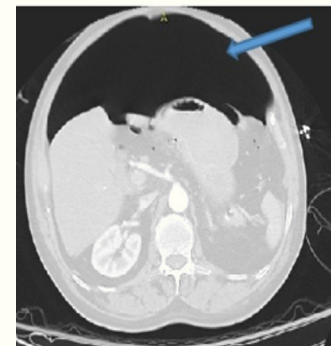
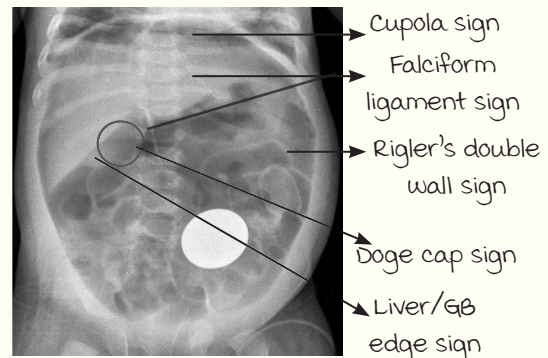


Abdominal x-ray erect

Pneumoperitoneum

### Signs on X-ray :

- Football sign : Large central oval lucency in the supine position d/t rising of air.
- Cupola sign : Free air lining the under surface of the central tendon of diaphragm.
- Falciform ligament sign : Free air lining both falciform ligaments creating a sharp margin.
- Liver/gallbladder (GB) edge sign : Visibility of sharp margins of liver/GB d/t air lining it.
- Rigler's double wall sign : Visibility of both mucosal & serosal surface of the bowel.
- Doge's cap sign : Triangular hat-like appearance of air trapped within the morrison's pouch.


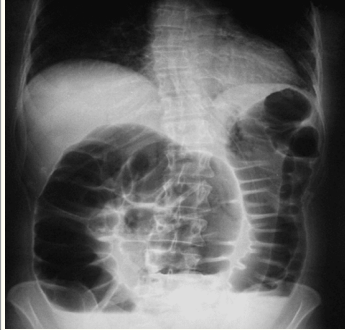


CT scan showing pneumoperitoneum

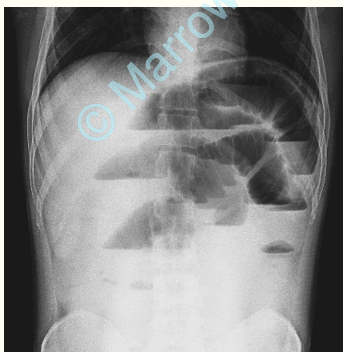
**Bowel obstruction :**

----- Active space -----

Small bowel vs large bowel obstruction :

| Variable                                | Small bowel.   | Large bowel.  |
|---|--|---|
| Diameter of dilated loops (3-6-9 rule). | >3 cm.   | >5 to 6 cm.<br>Caecum : >9 cm.  |
| Location of bowel loops.                | Central.   | Periphery.  |
| Number of loops.                        | multiple.  | Few, but massive.   |
| Air fluid levels.                       | multiple & short.  | Few & long.   |
| Gas in the large bowel.                 | No gas.  | Large bowel dilated proximal to the obstruction.                                    |
| Bowel wall markings.                    | Valvulae conniventes :<br>Complete transverse mucosal folds extending across the lumen of the small bowel. | Haustrations :<br>Transverse incomplete folds.                                      |
|   |                          |  |

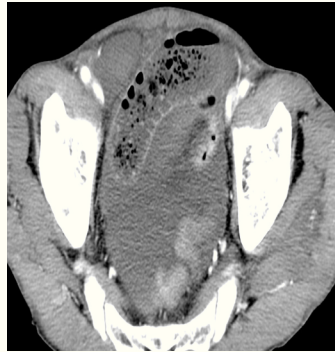
Signs in intestinal obstruction :



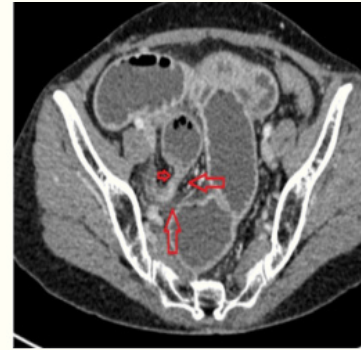
Step ladder appearance.

Small bowel feces sign :  
Fecal matter in small bowel d/t excessive stasis.

----- Active space -----



String of beads sign :  
Air trapped in valvulae conniventes.

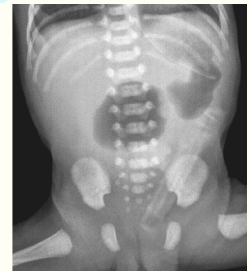


Transition point on CT : **most reliable** CT criteria. The bowel is dilated proximal to the transition point and collapsed distal to the transition point. Also gives an idea about the etiology of obstruction.

### Duodenal atresia :

Presentation : **Bilious vomiting at birth.**

Xray : **Double bubble sign.**



Double bubble sign

### Infantile hypertrophic pyloric stenosis (IHPS) :

Presentation : **Non-bilious vomiting at 6 weeks of age.**

IOC : USG (Pylorus thickness  $> 4\text{mm}$  & length  $> 16\text{mm}$  is diagnostic).

Signs in barium meal study :

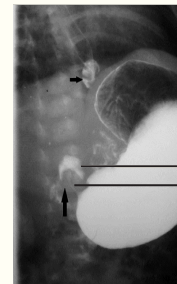
**Caterpillar sign** : d/t vigorous contraction of the stomach to push the contents.

**Shoulder sign** : Shouldering like narrowing into the pylorus.

**String sign** : Narrowed pylorus appears like a string.

**Double wall sign** : 2 layers of narrowed pylorus are seen.

**mushroom sign** : mushroom-like duodenum (D1).



Barium meal showing IHPS



Sigmoid volvulus

### Sigmoid & cecal volvulus :

Presentation : Abdominal distension & absolute constipation.

Risk factors : elderly female, K/C/O psychiatric illness.

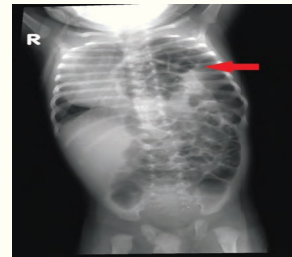
| Sigmoid volvulus (mc volvulus)  | Cecal volvulus  |
|---|-----------------|
| X-ray : 2 loops of massively dilated large bowel (d/t bending of the bowel)( <b>coffee bean sign</b> ). | 1 loop          |
| Haustrations lost.  | Haustrations +. |
| Dilated small bowel not seen.   | Seen.           |

**Congenital diaphragmatic hernia (CDH) :**

Presentation : Newborn with respiratory distress.

m/c cause of death : **Pulmonary hypoplasia.**

X-ray : Bowel loops in the thoracic cavity → mediastinal shift towards opposite side.


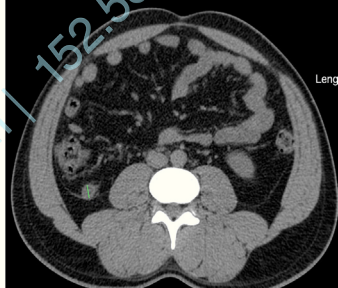


CDH

----- Active space -----

**Acute appendicitis :**

Presentation : Right lower abdominal pain with fever, vomiting, & tenderness at mCburney's point.

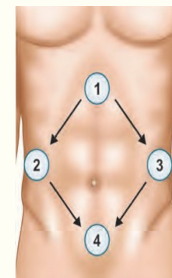
| USG findings   | CECT findings   |
|--|---|
| IOC in children.   | IOC in adults.  |
| Blind-ended tubular edematous structure in RIF with echogenic inflamed mesentery. Appendicolith ±. | Dilated appendix with periappendiceal inflammatory changes.                         |
|                  |  |

**Focussed assessment with sonography in trauma (FAST)**

00:13:07

**FAST protocol :**

1. Subxiphoid view : 1<sup>st</sup> view.
2. Longitudinal right upper quadrant : morrison pouch visualization (most dependent part of peritoneal cavity) → **Best view.**
3. Longitudinal left upper quadrant.
4. Suprapubic view.



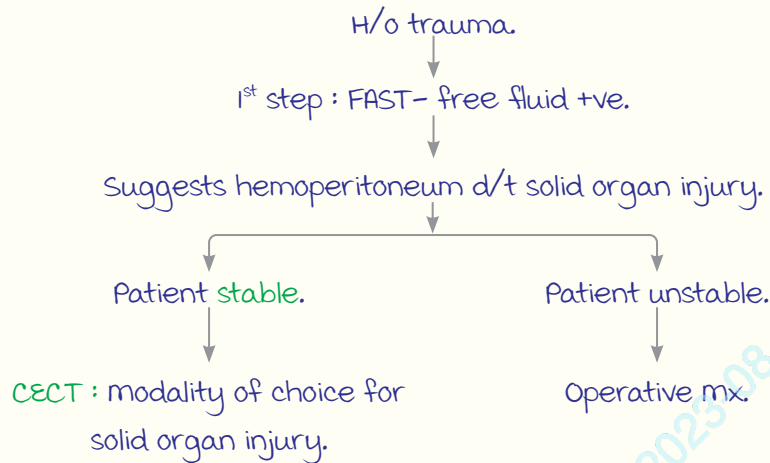
**extended-FAST (E-FAST) :**

Extend the assessment to the thoracic cavity.

- Posterior dependent part of the thorax → Look for hemothorax.
- Anterior non-dependent part of the thorax → Look for pneumothorax.

----- Active space -----

mx protocol :



## Barium spotters

00:15:55

### Esophagus :

#### 1. Esophageal web :

- Seen in Plummer Vinson syndrome (Paterson Brown Kelly syndrome) : Esophageal web + dysphagia + iron deficiency anemia + hypopharyngeal squamous cell carcinoma.



Esophageal web

#### 2. Zenker's diverticulum (m/c esophageal diverticulum) :

- Diverticulum is directed posteriorly.
- m/c complication : Aspiration.



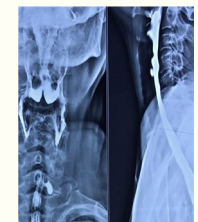
Zenker's diverticulum

#### 3. Killian-Jamieson diverticulum : Diverticulum is directed anteriorly.

#### 4. Achalasia cardia : **Bird beak sign** (Smooth elongated tapering like a bird's peak at the lower esophageal sphincter).

#### 5. Ca esophagus : **Rat tail appearance** (Abrupt narrowing of the esophagus with mucosal irregularity).

(Smooth rat tail in achalasia, Irregular rat tail in Ca esophagus).



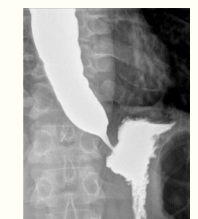
Killian-Jamieson diverticulum

#### 6. Diffuse esophageal spasm : Corkscrew esophagus/rosary bead/curling esophagus.

(Nut cracker esophagus in a barium swallow is normal).

#### 7. Feline esophagus/ esophageal shiver :

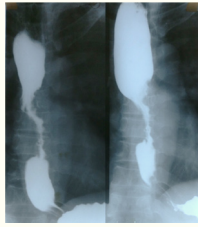
- Striated appearance d/t contraction of muscularis mucosa.



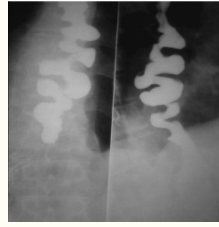
Bird beak sign

- Seen in reflux esophagitis, hiatus hernia, and eosinophilic esophagitis.

----- Active space -----



Rat tail appearance



Corkscrew esophagus



Feline esophagus

**Stomach :**

Peptic ulcer (Benign ulcer) vs Ca stomach (malignant ulcer) :

|  | Benign peptic ulcer                             | malignant gastric ulcer  |
|--|---|--|
| Location.  | Outside the lumen.                              | Within the lumen   |
| Hampton's line : Thin lucent line at the mouth of ulcer. | +   | -  |
| Carman's meniscus & Kirklin complex                      | -   | +  |
| mucosal folds.   | Regular folds.<br>Reach up to the ulcer margin. | Irregular nodular folds.<br>Interrupted (do not reach the ulcer margin). |

**Colon :**

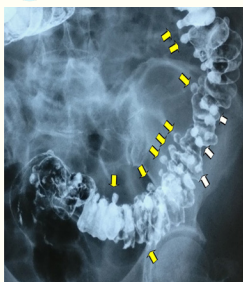
1. Colonic diverticula :

- Sawtooth sign (multiple outpouchings in the colon).
- IOC of diverticulitis : CECT

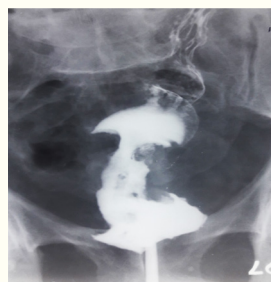
2. Ca colon : Apple core sign (left-sided Ca colon/rectum).

3. Ulcerative colitis :

- Lead pipe colon (loss of haustrations).
- Complication : Toxic megacolon (dilation of colon > 6cm).



Sawtooth sign



Apple core sign



Lead pipe colon

## Intussusception

00:22:57

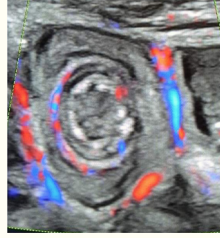
Presentation : Intermittent abdominal pain in a child with **red currant jelly stools**.

m/c site : ileocolic.

Signs in intussusception :



Coiled spring appearance  
in barium enema.



Target/Bull's eye/Doughnut  
appearance in USG.



Claw sign in barium  
enema.

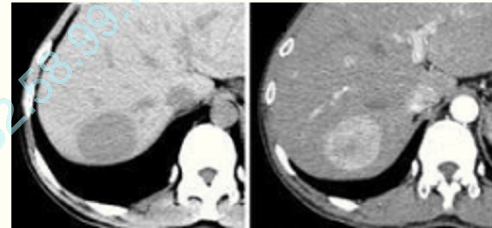
## Hepatobiliary system

00:23:52

**Hepatic adenoma :**

Presentation : Young female on OCPs,  
incidental detection of liver mass.

Lesion : Arterially enhancing.



Hepatic adenoma

**Hepatocellular carcinoma, fibrolamellar HCC & liver metastasis :**

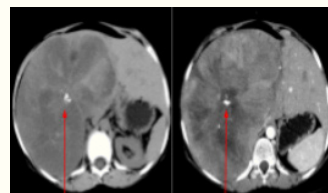
|                  | HCC.  | Fibrolamellar HCC.  | Liver metastasis.   |
|------------------|---|---|---|
| Age              | Elderly male.   | Young.  | Elderly.  |
| R/F              | K/C/O Cirrhosis.<br>Hepatitis B.  | No comorbidities.   | H/o 1° cancer (m/c :<br>Ca colon)   |
| Tumour<br>marker | AFP (alpha feta pro-<br>tein)   | Neurotensin B.<br>(normal AFP)  |   |
| Imaging          | CECT : Lesion<br>enhancing on the<br>arterial phase & wash-<br>ing out on the delayed<br>phase. | CECT : Large<br>arterially enhancing<br>mass with a<br>central calcified <b>stel-<br/>late scar</b> . | CECT : multiple<br>hypovascular<br>lesions (enhance<br>less compared to<br>normal liver).<br>PET-CT : Hot spots |



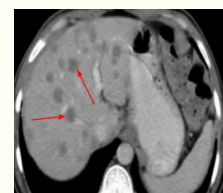
HCC - Enhancing  
on arterial phase



HCC - Washout on  
delayed phase



Fibrolamellar HCC

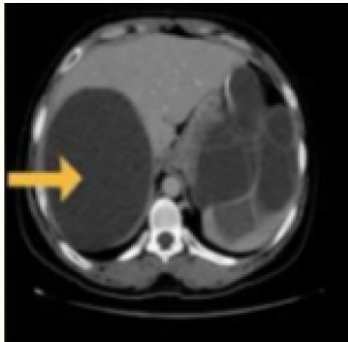


Liver metastasis -  
PET CT- hotspots

Hydatid cysts :

Stages of hydatid cyst :

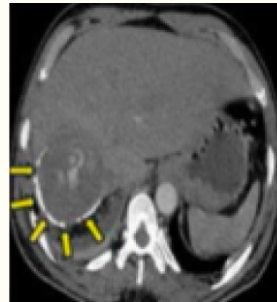
----- Active space -----



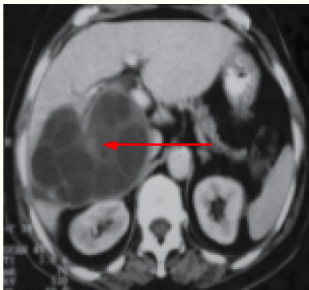
1. Simple cyst.



2. Snowstorm sign (mobile contents appear within the cyst & change its position).



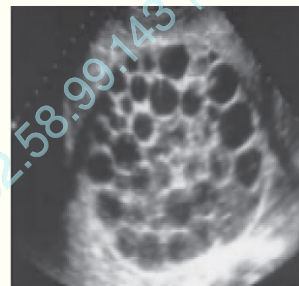
3. Peripheral curvilinear calcifications.



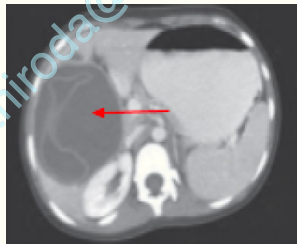
4. Daughter cysts within mother cyst.



5. Wheel spoke sign (Hydatid sand trapped in b/w daughter cyst).

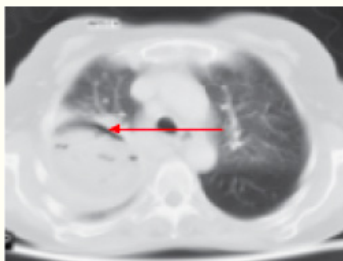


6. Honeycomb's sign (Entire mother cyst filled up with daughter cyst).

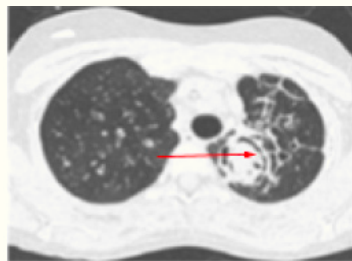


7. Floating membrane sign (Degenerated membrane floats within mother cyst).

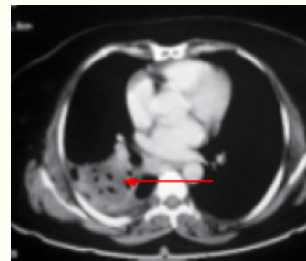
Hydatid cyst in lung :



1. Air crescent sign. Crescent of air on top of the cyst d/t communication with bronchus.



2. Inverse crescent sign. Air on the dependent part of the cyst.

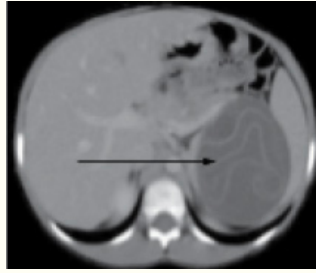


3. Air bubble sign.

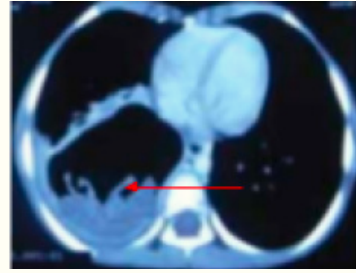
----- Active space -----



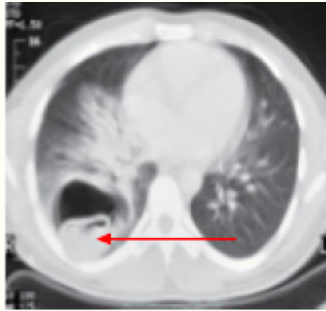
4. Combo sign (2 air-fluid levels (one in the wall & one within the lumen of the cyst)).



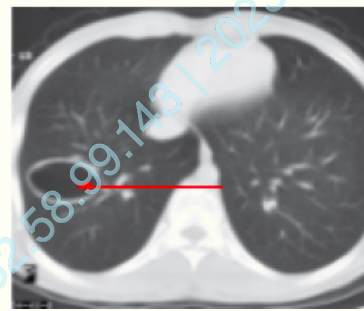
5. Whirl/serpent sign. Cyst contents are thrown out & more air enters into the cyst (membrane degenerates & floats within the cyst).



6. Floating waterlily sign/ Camalote sign. Few of the membranes float on the surface.



7. Rising sun sign/mass within a cavity sign : Contents clumped at the bottom of the cyst.



Empty cyst sign : All contents expectorated out & cavity becomes empty.

**Gall bladder (GB) :**

00:30:35

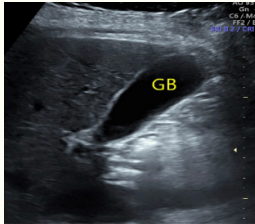
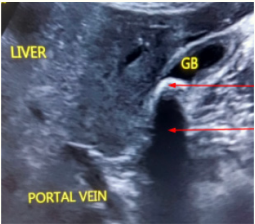
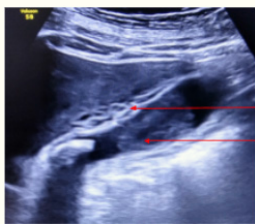
Phrygian cap :

- Anatomical variant of GB.
- misinterpreted as GB septum/mass.



Phrygian cap

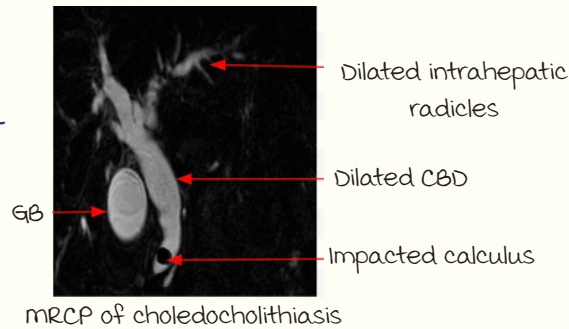
Normal GB vs GB stones :

| Normal GB.  | GB calculus   | Calculous cholecystitis.  |
|---|---|---|
| Anechoic (Jet black), distended on the undersurface of the liver, clear bile.       | An echogenic lesion with a dense shadow behind it.                                  | Edematous & thickened GB, debris within it.   |
|  |  |  |

----- Active space -----

**Cholelithiasis**

Impacted calculus within common bile duct with dilated CBD & intrahepatic biliary radicles.

**Pancreas imaging**

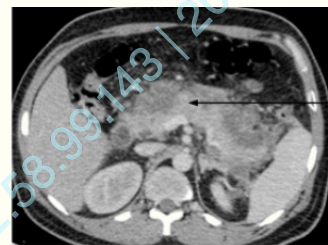
00:32:52

**Acute pancreatitis :**

Presentation : K/C/O alcoholic with epigastric pain radiating to back.

Lab investigation : ↑ S. amylase & lipase.

CT : Bulky pancreas with hazy margins, peripancreatic fluid.



Severity :

- Balthazar grading.
- CT severity index : Balthazar grading with presence/absence of pancreatic necrosis.

Better correlation with overall morbidity & mortality.

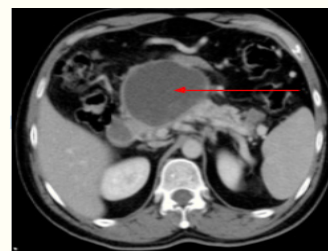
**Pancreatic pseudocyst :**

Fluid collection in the pancreas as a complication of pancreatitis.

Presentation : Epigastric fullness & mass after a few weeks of an acute attack of pancreatitis.

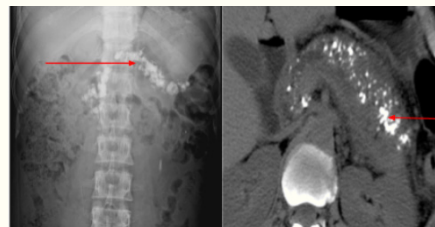
m/c site : Lesser sac.

m/c complication : Secondary infection.

**Chronic calcific pancreatitis :**

H/o recurrent pancreatitis.

Diffuse calcification of pancreatic parenchyma.



## Genitourinary tract (GUT)

00:34:45

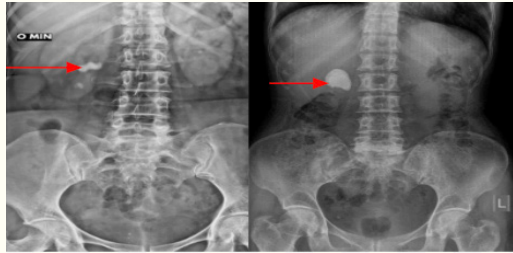
### Urolithiasis :

Initial Ix : X-ray KUB

USG : Done for acute renal colic. (Note : USG is the IOC for hydronephrosis).

IOC : NCCT (for renal & ureteric calculi).

CT occult calculi : Indinavir & pure matrix calculi.



Renal calculi on X-ray KUB



Staghorn calculus :

made of struvite (ammonium triple phosphate).



Jackstone vesical calculus.



Emphysematous pyelonephritis

### Emphysematous pyelonephritis :

Presentation : Fever with turbid urine, diabetic, hypotension.

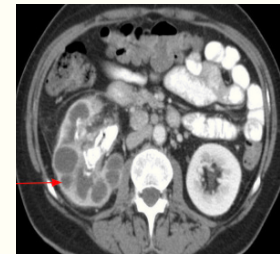
X-ray : Air within the renal fossa.

### Xanthogranulomatous pyelonephritis :

Associated with chronic calculus disease.

Proteus/E coli infection.

CT : Bear paw sign (multiple fluid-filled spaces with central impacted calculi in an enlarged kidney).



Bear paw sign

### GUT TB :

Sterile pyuria +

Investigations :

- Earliest diagnosis : IVU (intravenous urography).
- Overall IOC : CECT.



moth eaten calyx :  
Earliest finding on IVU.



Putty kidney : kidney  
calcification in long-standing  
cases → Autonephrectomy.

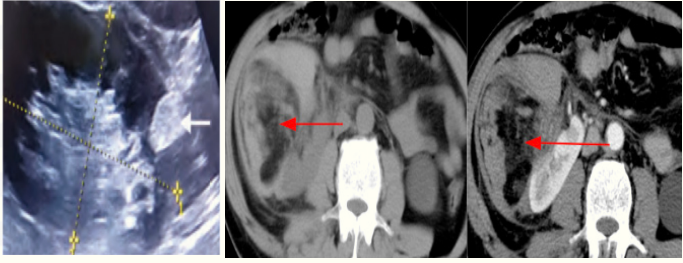



Thimble bladder : Bladder  
wall thick & inflamed →  
Limited capacity.

Renal tumors :

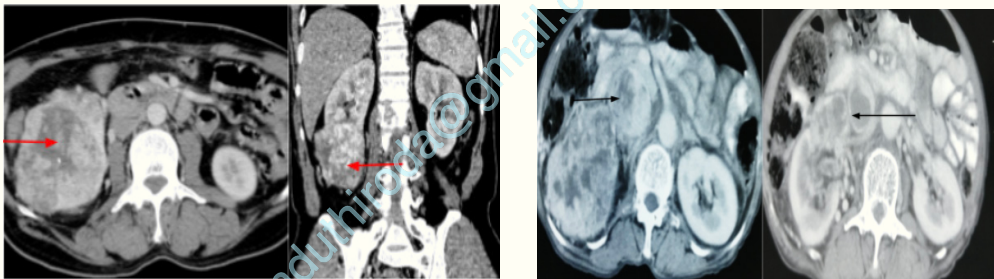
----- Active space -----

1. Renal angiomyolipoma & 2. Renal oncocytoma :

| Renal angiomyolipoma   | Renal oncocytoma   |
|--|--|
| <p>A/w tuberous sclerosis.</p> <p>USG : Renal cortex shows bright hyperechoic mass.</p> <p>CT : mass with central fat density.</p> | <p>A renal lesion with a central stellate scar.</p>                                |
|   |  |

3. Renal cell carcinoma :

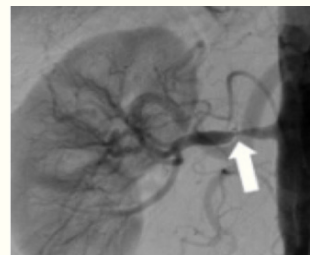
- Presentation : Painless gross hematuria in an adult.
- IOC : CECT (heterogeneously enhancing mass lesion).
- IOC for renal vein/IVC extension : CE-MRI.



CT image showing renal vein invasion

Renal artery stenosis/ renovascular hypertension :

- 1<sup>st</sup>/screening : Renal artery doppler.
- IOC : CT angiography/mr angiography.
- Gold standard : Invasive catheter angiography.
- Detect functional significance of stenosis : Captopril, DTPA scan.



Fibromuscular dysplasia :

String of beads/pearls appearance (alternate dilatations & constrictions of the renal artery).



----- Active space -----

**IVU spotters :**

1. Horseshoe Kidney : Parenchyma fused across midline.

2. Cross-fused ectopic left kidney :

- Left kidney fused with right kidney.
- Left renal fossa empty.

3. Duplex pelvicalyceal system :

Weigert-meyer law :

- Upper moiety ureter : Inserts medially & inferiorly & prone to ureterocele (mnemonic : u-mi-u).
- Lower moiety ureter insertion is lax, and prone to reflux.

4. Duplex pelvicalyceal system with an obstructed upper system (Drooping lily sign : Obstruction → dilated upper moiety push the lower moiety downwards).

5. Pelviureteric junction obstruction.

6. Ureterocele : Cobra head/adder head/spring onion appearance (focal cystic dilation of terminal ureter).

7. VUR (vesicoureteric reflex) :

- IOC : MCU (micturating cystourethrogram) : Reflex into both ureters on voiding.
- IOC for follow up : Radionuclide cystography.

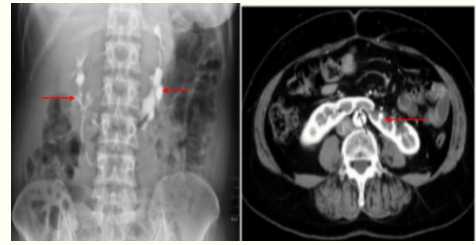
8. Posterior urethral valve : male neonate with narrow urinary stream.

- Antenatal USG : Key hole sign (dilated urinary

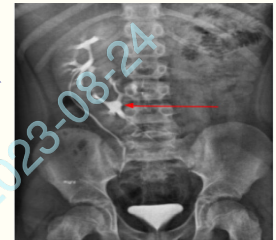
bladder with dilated posterior urethra).

9. Stricture urethra :

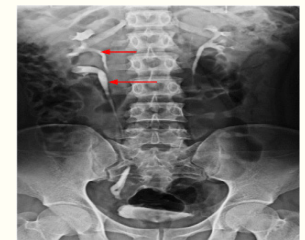
- Presentation : Adult with recurrent UTI & narrow urinary stream.
- RGU (retrograde urethrography) : Narrow urethra seen.



Horseshoe Kidney



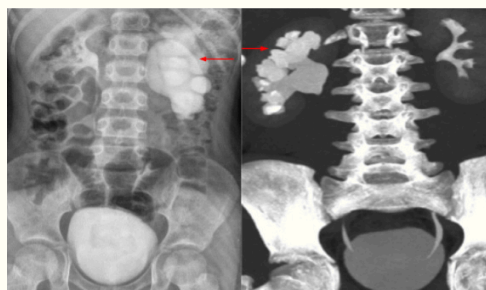
Cross-fused ectopic left kidney.



Duplex pelvicalyceal system.



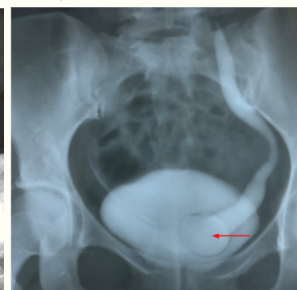
Duplex pelvicalyceal system with obstructed upper system.



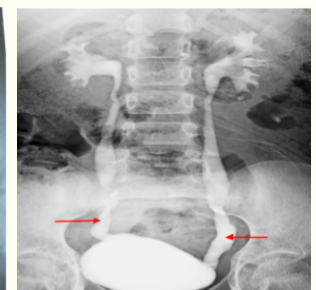
IVU

CT-IVU

PUJ obstruction : Hydronephrotic kidney with dilated pelvis, ureter not visible.

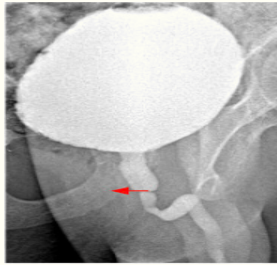


Cobra head

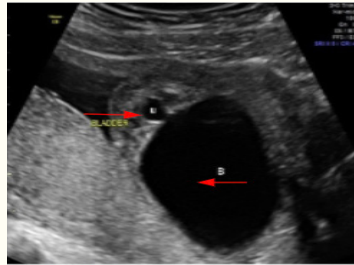


MCU of VUR

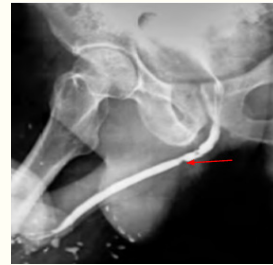
----- Active space -----



Posterior urethral valve.



Key hole sign (red arrows pointing dilated UB & urethra)



Stricture urethra

## Breast imaging

00:47:17

mammography vs USG :

|            | mammography  | USG           |
|------------|--------------|---------------|
| Age group. | Elderly.     | Young.        |
| Density.   | Low density. | High density. |

Imaging for breast cancer :

- IOC for screening : mammography.
- Overall IOC : CE-MRI.

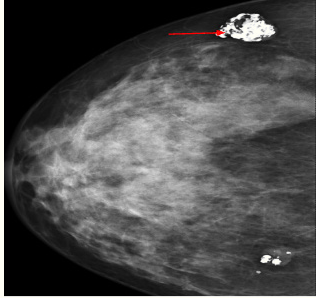
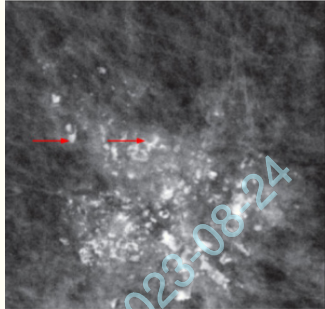
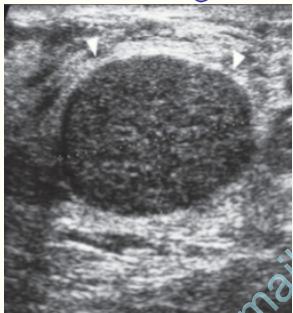
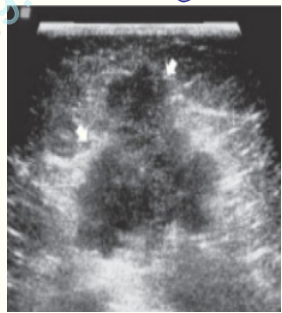
American society of breast surgeons recommendations for breast cancer screening-2019 : Formal clinical risk assessment to be done at 25 years.

Screening based on risk factors :

| Status  | Risk         | Age group of screening | IOC for screening |
|---|--------------|------------------------|-------------------|
| 1. Women with mutation carrier status (BRCA1/2)/ prior chest wall irradiation at 10 to 30 years of age. | High.        | 25 years.              | Annual CE-MRI     |
|   |              | 30 years.              | mammography.      |
| 2. Women with strong family history/predicted lifetime risk >20%.                                       | Intermediate | 35 years.              | mammography       |
| 3. Women with no risk factors.  | Average.     | 40 years.              | mammography       |

----- Active space -----

## Difference b/w benign &amp; malignant lesions in mammography :

| Benign   | malignant   |
|--|---|
| <p>macrocalcifications &amp; popcorn calcifications (Involuting fibroadenoma).</p>  | <p>Pleomorphic clustered microcalcification.</p>                                 |
| <p>Oval lesion : wider than taller with smooth margins.</p>                        | <p>Irregular lesion : taller than wider with spiculated/irregular margins.</p>  |

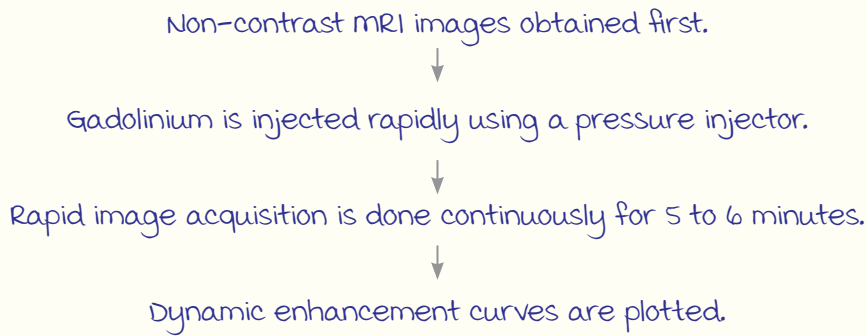
## BI-RADS :

Breast imaging reporting &amp; data system : 7 categories.

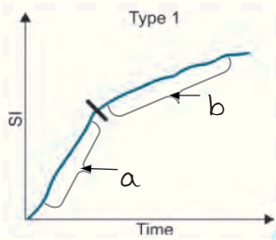
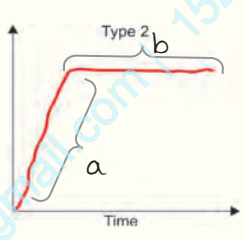
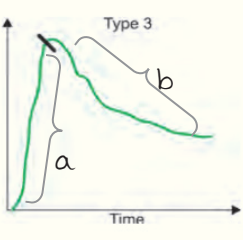
| BI-RADS category  | management                               | Cancer likelihood |
|---|--|-------------------|
| 0<br>Incomplete evaluation.   | Additional imaging needed.               | Cannot comment.   |
| 1.<br>Negative.   | Continue routine screening.              | 0                 |
| 2.<br>Benign (Fibroadenoma).  |  | 0                 |
| 3.<br>Probably benign.  | Short interval screening (twice yearly). | 0- <2%            |
| 4.<br>Suspicious (irregular lesion with few lobulations).   | Biopsy                                   | 4a : 2 to 10%.    |
|   |  | 4b : 10 to 50%.   |
|   |  | 4c : 50 to 95%.   |
| 5.<br>Highly suggestive of malignancy (irregular, spiculated, taller than wider lesion with pleomorphic calcification). | Biopsy                                   | >95%              |
| 6.<br>Biopsy proven malignancy.   | Rx of malignancy.                        |                   |

**Dynamic contrast enhanced breast MRI :**

Steps :

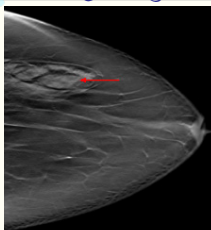
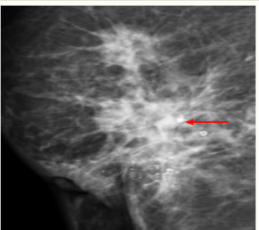


Types of dynamic MRI enhancement curves :

| Type        | Type 1   | Type 2   | Type 3   |
|-------------|--|--|--|
| Upslope (a) |  | Rapid  |  |
| Delayed (b) | Slow rise  | Plateau  | Decline/washout.   |
|             |  |  |  |
| Signifies   | Benign   | Intermediate   | malignancy   |

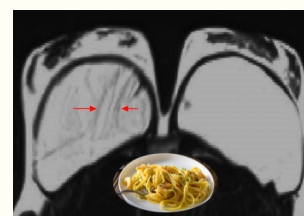
**Spotters :**

mammography spotters :

| Hamartoma/fibro-adeno-lipoma  | Breast carcinoma   |
|---|--|
| Breast within a breast appearance on mammography.                                   | Spiculated mass with multiple pleomorphic microcalcifications.                       |
|  |  |

mri spotter :

**Linguine sign :** Intracapsular rupture of the breast implant.



## Obstetrics & gynaecology imaging

00:55:14

----- Active space -----

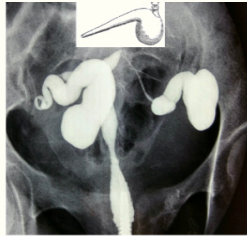
HSG spotters :



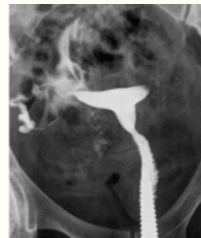
1. Unicornuate uterus



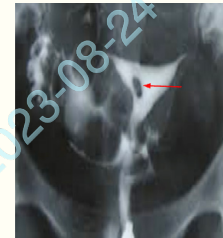
2. Bicornuate uterus



3. Hydrosalpinx : Retort shaped dilated fallopian tube, & no free peritoneal spill

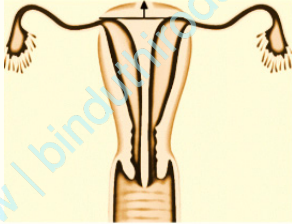
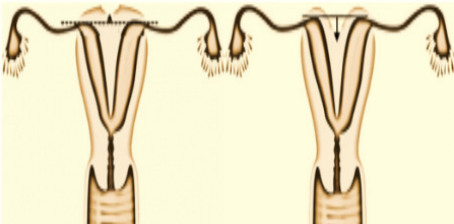


4. Left sided cornual tubal block : No free peritoneal spill on the left side



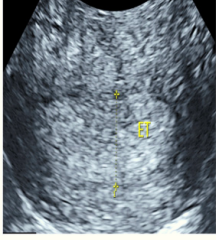
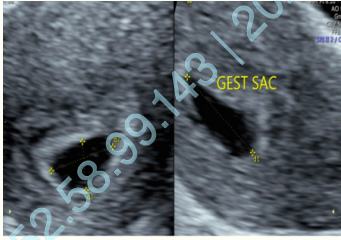
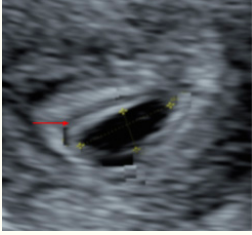
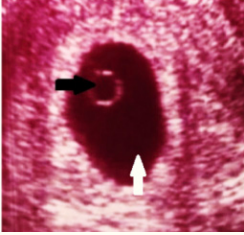

5. uterine synechia/ adhesion : Filling defects seen

Septate uterus vs bicornuate uterus :

| Septate uterus  | Bicornuate uterus  |
|---|--|
| Fundus >5 cm from the tubal ostia line.   | Fundus <5 cm from the tubal ostial line or it dips below.                            |
|  |  |

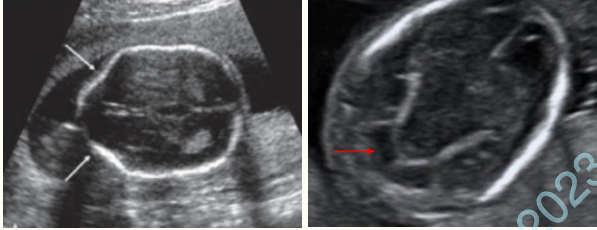
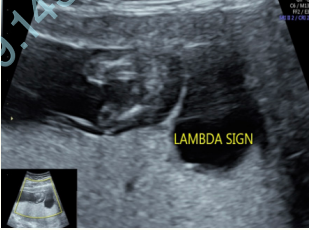
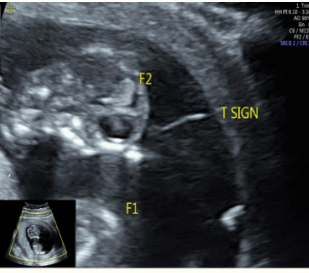
----- Active space -----

Obstetrical imaging in early pregnancy :

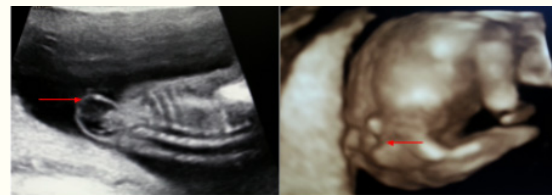
| Duration        | Signs   | Radiological images  |
|-----------------|---|--|
| Around 4 weeks. | Thickened (>10mm) echogenic endometrium.  |    |
| 4 to 5 weeks.   | <p>Gestational sac seen : Intradecidual sac sign (single echogenic chorionic rim around it).<br/>mean sac diameter measured.</p> <ul style="list-style-type: none"> <li>• TVS : 4 and a half weeks.</li> <li>• Transabdominal USG : 5 weeks.</li> </ul> |    |
|                 | <p>Double decidual sac sign : Typical sign of intrauterine gestational sac.</p> <ul style="list-style-type: none"> <li>• Outer echogenic rim : Formed by decidua parietalis.</li> <li>• Inner echogenic rim : Formed by decidua capsularis.</li> </ul>  |   |
| 5 to 6 weeks.   | Yolk sac : 1 <sup>st</sup> structure seen in a gestational sac.   |  |
|                 | Double bleb sign : Yolk sac + amnion.   |  |

----- Active space -----

## Obstetric imaging spotters :

| Diagnosis                          | Signs   |  |
|------------------------------------|---|--|
| Arnold Chiari type 2 malformation. | <p><b>Lemon sign</b> : Lemon shaped skull.</p> <p><b>Banana sign</b> : Banana shaped cerebellum d/t small posterior fossa.</p>  |  |
| Dichorionic pregnancy.             | <p><b>Twin peak sign/lambda sign</b> : Chorionic tissue extends into the separating membrane resulting in a triangular tapering.</p>  |   |
| Monochorionic pregnancy.           | <p><b>T sign</b> : Separating membrane attaches to the chorionic tissue at right angle without extension of the chorionic tissue within the membranes.</p>  |  |

Lumbar meningomyelocele : CSF leaking via open spina bifida resulting in decompression of intracranial pressure.



## Musculoskeletal system

01:00:09


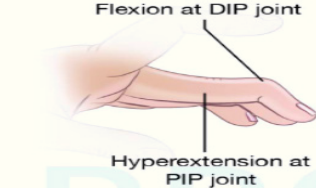

### Rheumatoid arthritis :

Earliest joint : MCP (metacarpophalangeal) + PIP (proximal interphalangeal).

Seropositive : RA factor +ve.

Earliest finding : Erosion involving the ulnar styloid process.

Deformities :

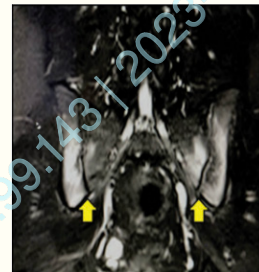
| Boutonniere deformity   | Swan neck deformity   | mallet finger  |
|---|---|--|
| Flexion at PIP joint & extension of DIP.  | Extension of PIP joint & flexion at DIP joint.                                    | Fixed flexion at DIP joint.  |
|  |  |  |

**Ankylosing spondylitis (AS) :**

Seronegative.

HLA B27 +ve.

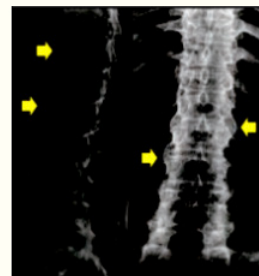
Earliest/mc joint involved : Sacroiliac joint  
(Best diagnosed on MRI).



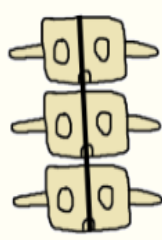
Sacroiliac joint involvement on MRI.

Signs in AS :

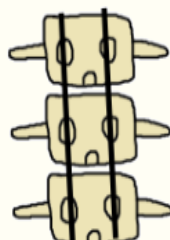
1. Shiny corner sign : Sclerotic corners of vertebral bodies d/t enthesitis.
2. Romanus lesion : Erosions of vertebral bodies at the corners.
3. Squaring of vertebra.
4. Bamboo spine/Poker's spine : Fusion of adjacent vertebral bodies d/t bridging syndesmophytes resulting in a bamboo like appearance.
5. Carrot stick fracture : Fracture of the fragile vertebra.
6. Anderson's lesion : Pseudoarthrosis at the fractured site d/t poor healing.
7. Dagger sign : Calcification of interspinous ligaments.
8. Railroad track sign : Calcification of B/L paraspinous ligaments.
9. Trolley track sign : Calcification both interspinous & paraspinous ligaments.



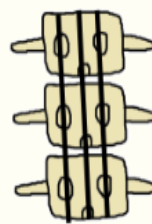
Bamboo spine



Dagger sign



Railroad track sign






Trolley track sign

----- Active space -----

**Psoriatic arthritis :**

Features :

|   |   |   |
|---|---|---|
| mouse ear sign  | Pencil in cup/cup & saucer/Pestle & mortar/balancing Pagoda sign                  | Sausage digit/opera glass hand deformity  |
| Fluffy periosteal reaction around the erosion.                                    | One bone telescopes into another bone.  | Wide stubby fingers d/t shortening of bones.  |
|  |  |  |

**Gout :**

Features :

- Severe pain & inflammation at 1<sup>st</sup> MTP joint.
- Eccentric erosions at the site of involvement with preserved joint space.
- **martel's G sign**/overhanging margin sign : Eccentric tophi with overhanging bone.



martel's G sign

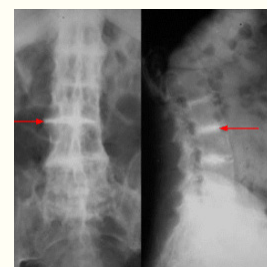
**Pseudogout :**

- Calcium pyrophosphate deposition in the joint.
- meniscus calcifications +

**Alkaptonuria/ochronosis :**

Features :

- Ochronosis.
- middle aged woman with h/o backache.
- Bluish black discolouration of nose & ears.
- x-ray : Calcified intervertebral disc.



### Neuropathic/Charcot's joint :

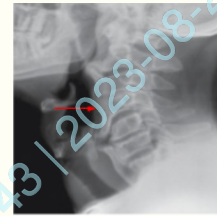
- Painless condition.
- Seen in neuropathic conditions (diabetes, leprosy, tabes dorsalis, subacute combined degeneration of cord, syring, etc).
- Grossly deformed bones & joints.
- Licked candy stick appearance : Tapered bones d/t destruction.



Licked candy stick appearance.

### DISH (diffuse idiopathic skeletal hyperostosis) :

- Flowing hyperostosis involving atleast 4 adjacent vertebral bodies.
- Flame shaped osteophytes/ dripping candle wax appearance : Flowing hyperostotic bone formation along the anterior longitudinal ligament.



Dripping candle wax appearance.

### Osteomyelitis :

Chronic osteomyelitis - Features :

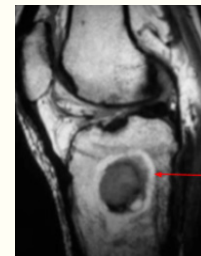
- Sequestrum : Dead infarcted bone. Reservoir of infection.
- Involucrum : Thick layer of periosteal new bone formation.
- Cloaca : Tract/defect within bone extending upto the skin.



Cloacal tract

Subacute osteomyelitis :

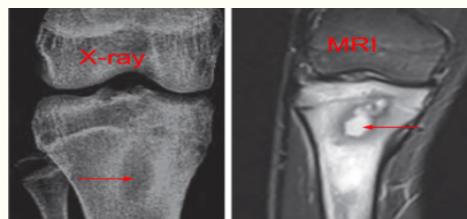
T<sub>1</sub>W MRI : Penumbra sign (bright hyperintense appearing margin around the lesion d/t vascularized granulation tissue).



Penumbra sign



Brodie's abscess :

- Aborted form of subacute osteomyelitis.
- MC site : Proximal tibia.
- MC organism : S.aureus.
- Presentation : Child with nocturnal pain relieved by analgesics.
- X-ray : Proximal tibial lucent lesion with a sclerotic margin.

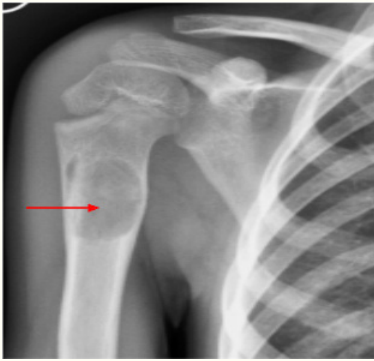
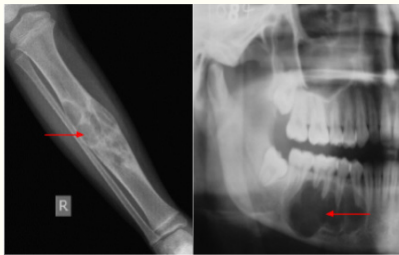



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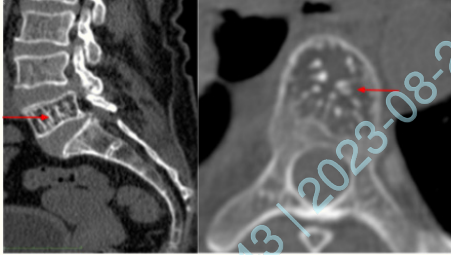

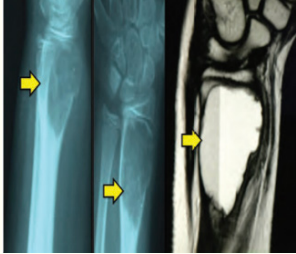
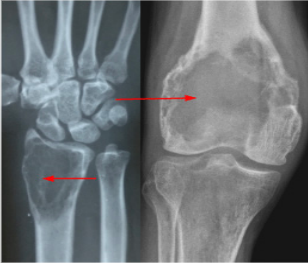
**Tuberculosis :**

| Pott's spine  | Spina ventosa/TB dactylitis   |
|---|---|
| Discal & paradiscal involvement predominantly.                                    | Expansion of short tubular bones like metacarpals.                                  |
|  |  |

**Bone tumours :**


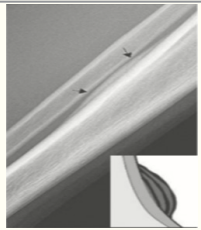


| Disease           | Description   | Radiological image  |
|-------------------|---|---|
| Simple bone cyst. | Site : Proximal humeral metaphysis in an immature skeleton.<br>Lesion : Centrally located cystic lesion.<br>Hinged fragment sign : Fracture of the fragment.<br>Fallen fragment sign : Fragment falls down within the tumour. |   |
| Adamantinoma.     | Site : Tibial diaphysis > mandible.<br>Lesion : Soap bubble like expansile lesion/honeycomb like.   |   |
| Enchondroma.      | Site : Short tubular bones of the hands & feet.<br>Lesion : Lytic expansile lesion.   |  |

----- Active space -----

|                                       |   |  |
|---------------------------------------|---|--|
| <p>Osteoid osteoma.</p>               | <p>Site : Cortex of the femur, lumbar spine.<br/>Lesion : O shaped lesion.</p>  |    |
| <p>Hemangioma.</p>                    | <p>Site : Spine/skull.<br/>Lesion : Corduroy cloth vertebra (striated), polka dot appearance (in cross section).</p>  |    |
| <p>Osteochondroma/<br/>exostosis.</p> | <p>MC benign bone tumour.<br/>Lesion : Outgrowth directed away from the adjacent joint.<br/>Risk of malignancy :<br/>• Isolated exostosis : 1%<br/>• Diaphyseal aclasia (hereditary multiple exostosis) : 20%</p> |   |
| <p>Aneurysmal bone cyst (ABC)</p>     | <p>Lesion : Eccentric lytic soap bubble lesion in a child.</p>  |  |
| <p>Giant cell tumour.</p>             | <p>Lesion : Eccentric lytic soap bubble lesion an adult.</p>  |  |

----- Active space -----

Periosteal reactions :

| Solid   | Lamellated   | Sunburst/<br>spiculated  | Codman's triangle.  |
|---|--|--|---|
| Seen in osteoid osteoma.  | Onion peel like.<br>Seen in Ewing's sarcoma : diaphysis origin, skip lesions +, bony metastases +. | Both Ewing's & osteosarcoma.   | Periosteum lifted off from the surface of the bone.<br>Seen in osteosarcoma : metaphyseal origin. |
|  |                   |  |                |
| Benign/ less malignant  |  |  | more malignant  |

multiple myeloma :

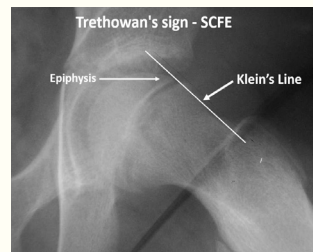
Rain drop skull : multiple round punched out lytic lesions in the skull.



Raindrop skull

Slipped capital femoral epiphysis :

- Presentation : Obese patient with hip pain.
- Klein's line : Line drawn along the superior cortex of the femoral neck. It must cut across some part of the femoral head epiphysis.
- Trethowan's sign : If the line does not cut across the femoral head, d/t slipping of capital femoral epiphysis.



Trethowan's sign



Osteogenesis imperfecta :

- Type I collagen defect.
- Multiple bone fractures.
- Can be diagnosed antenatally.
- Grossly deformed thin bones.
- Shepherd crook deformity.



Shepherd crook deformity