The role of CT scan in the management of colorectal malignancy.

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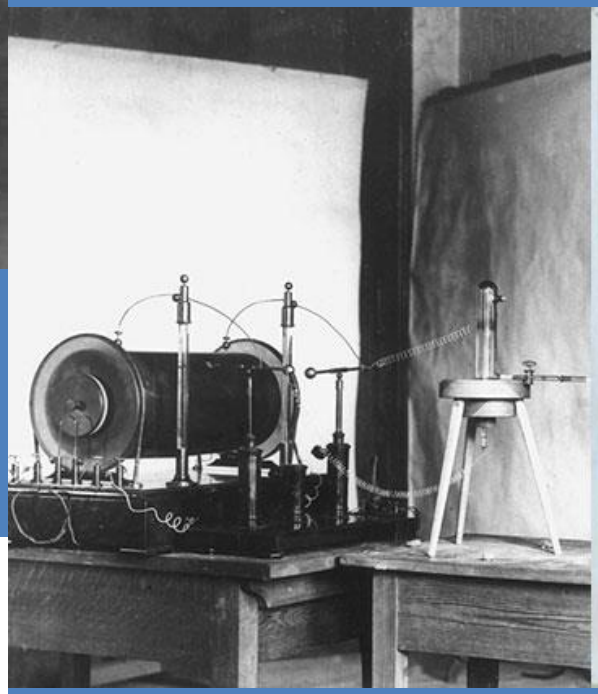
So, what's the difference in between 2

- Same.
  - CAT -used earlier in its history.
  - CT - recent up-to-date term.
- Early beginning---
  - EMI scan.
  - Named for the EMI Company.

From x-rays to multislice CT scans: A brief history

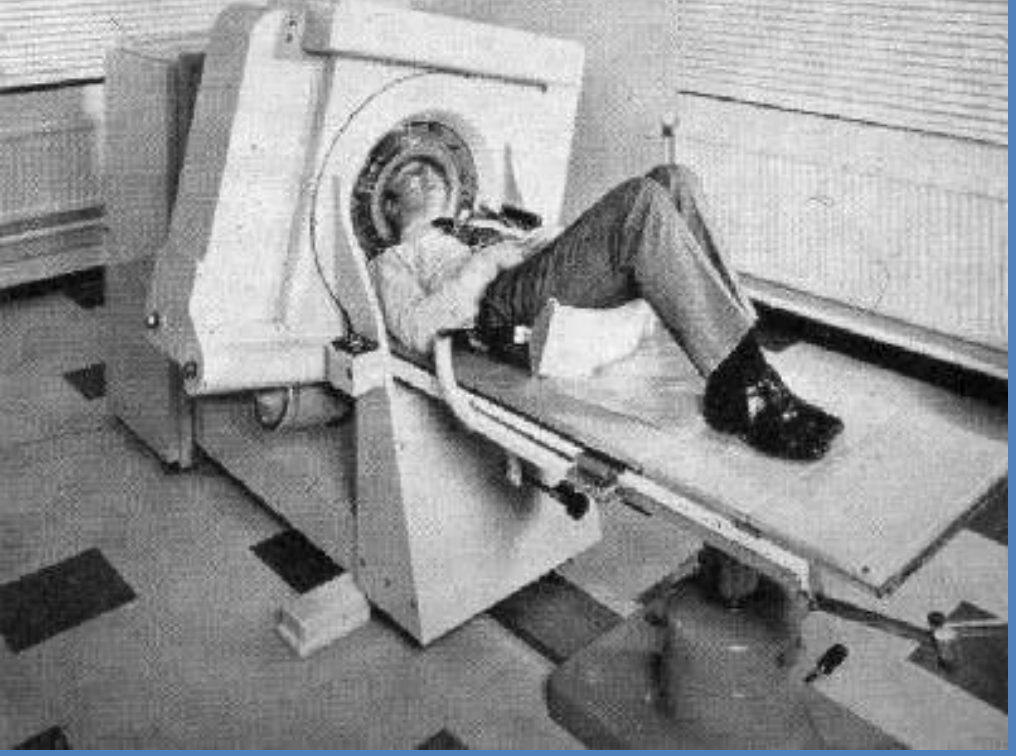
Wilhelm Röntgen, Nobel prize in physics, 1901

A print of the left hand of Anna Bertha Ludwig Röntgen, 22 Dec.1895



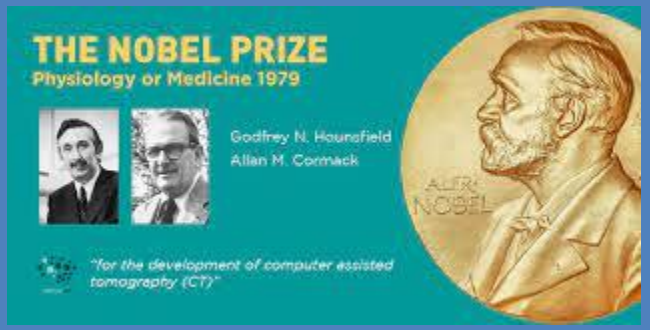
In 1895 a German physicist **Wilhelm Conrad Röntgen** 1st detected **x-rays**.

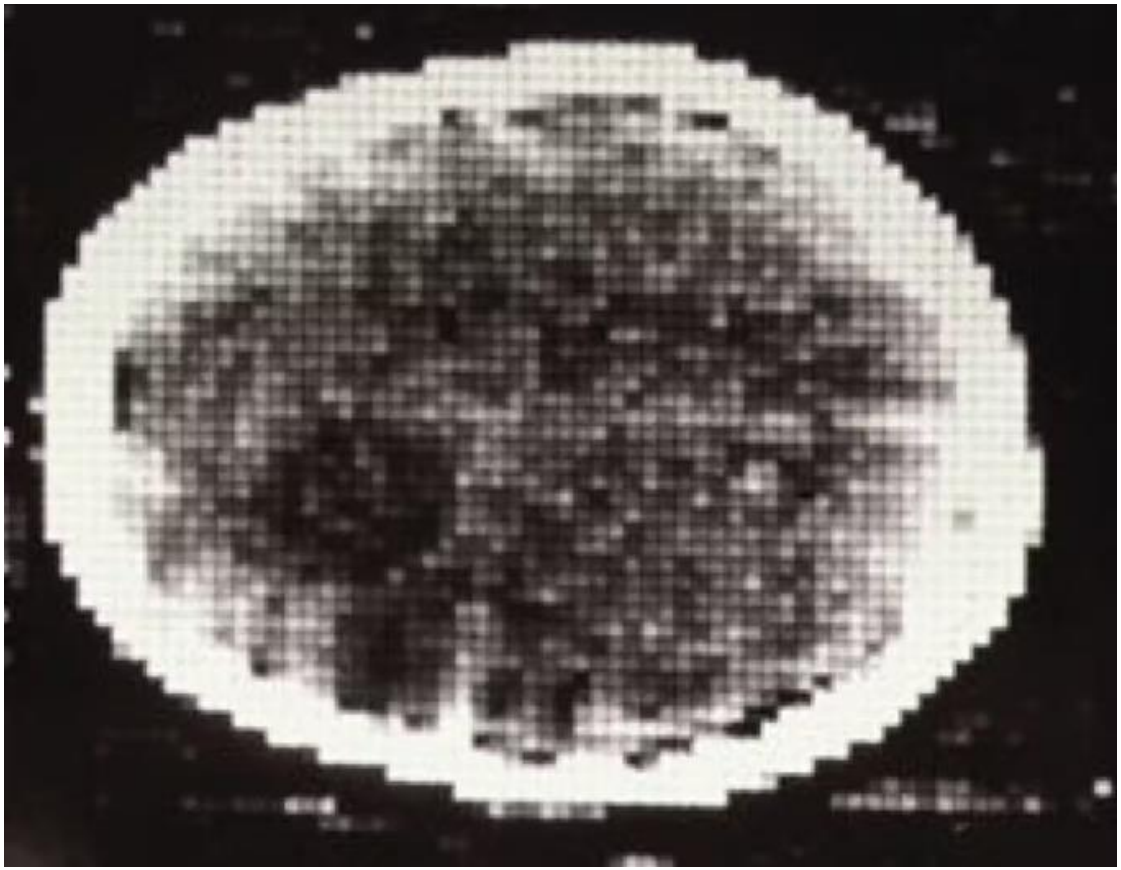
Usage of x-rays in medicine in 1896.



1st commercial CT- 1st October 1971 by Sir Godfrey Hounsfield.

Nobel prize- 1979.

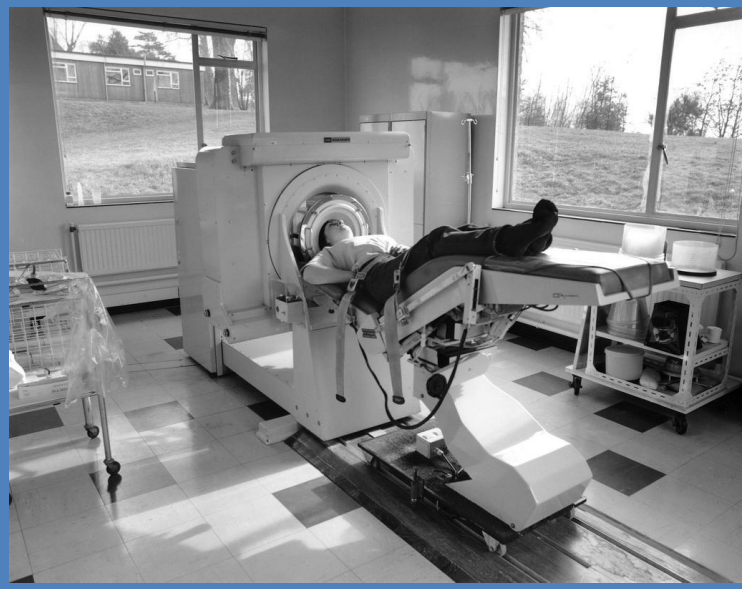




History of CT scan

- These 1st images were blurry and took a lot of time.
- Pictures with an 80×80 resolution & 5 minutes for each image.
- Nowadays 1024×1024 resolution with a scan time 0.3 sec/frame.

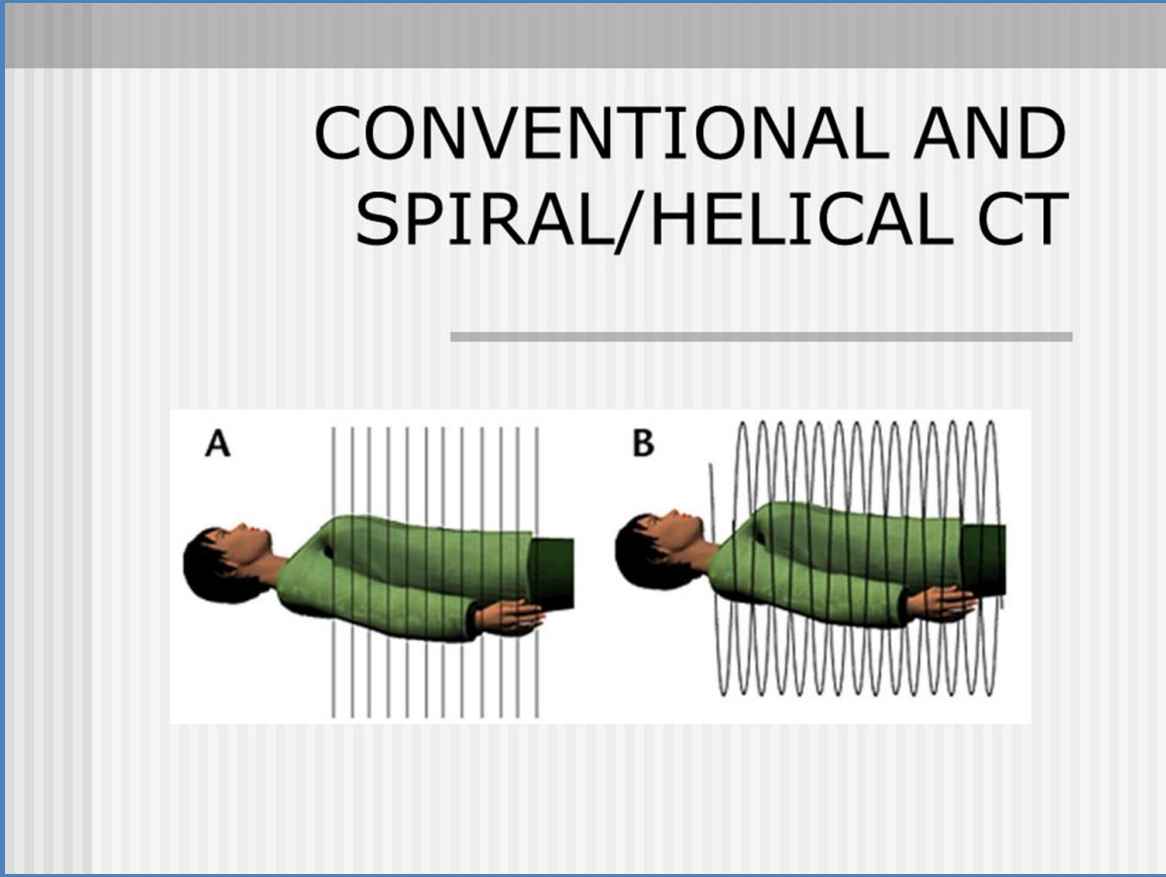
Generations of CT



- 1st generation- EMI scanner.
- 2nd generation- reducing time.
- 3rd generation- wide fan beam.
- 4th generation-
- 5th generation- Electron beam CT.
- 6th generation- Spiral CT.
- 7th- Multiple detector array.

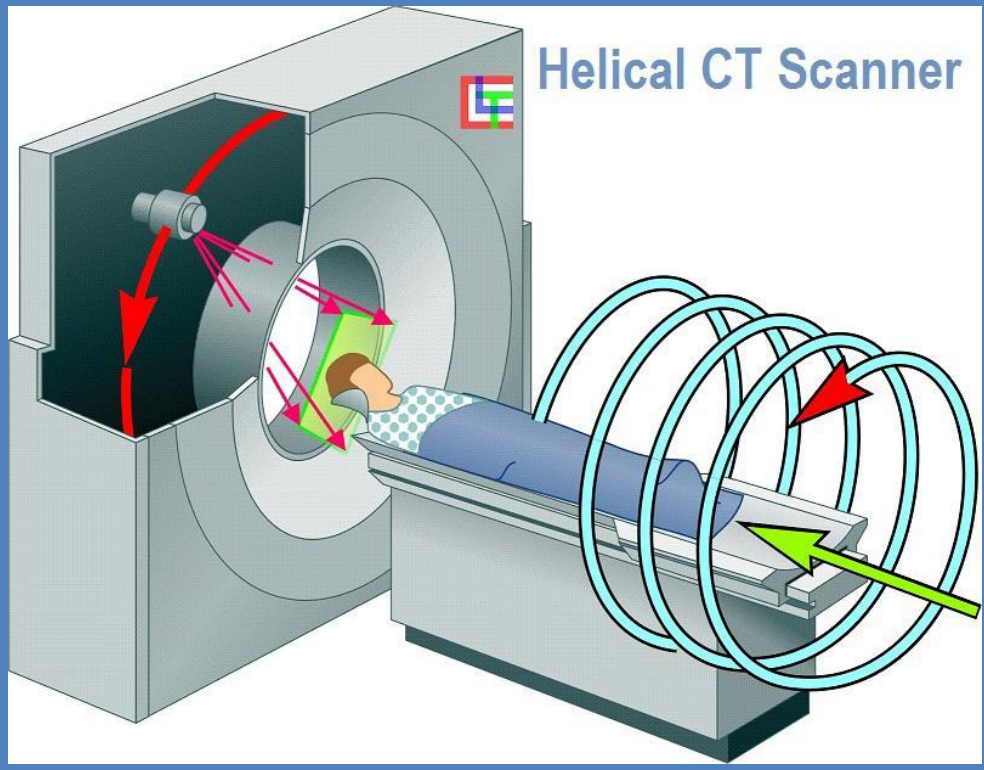
Types of CT scanner

- Conventional or serial.
- Helical or spiral.



6th generation CT

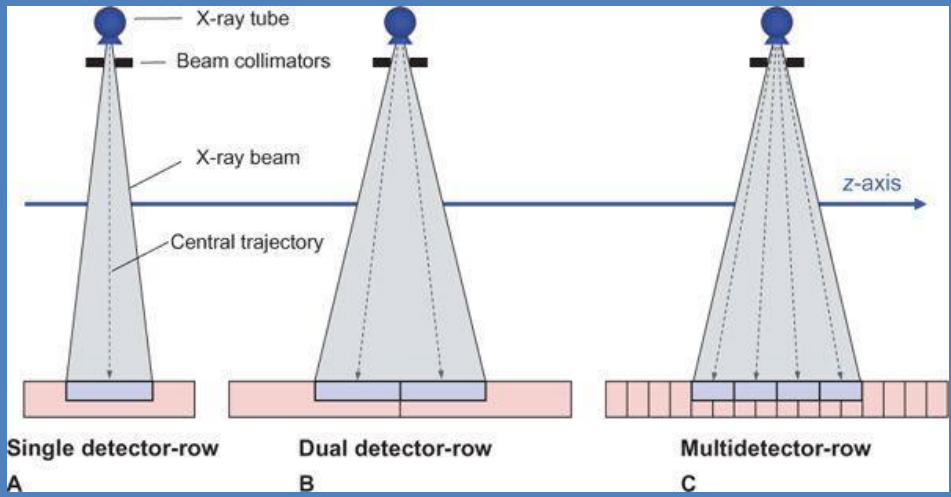
- Helical/ Spiral CT.
- Collects image by moving around the patient.
- Mostly used nowadays.

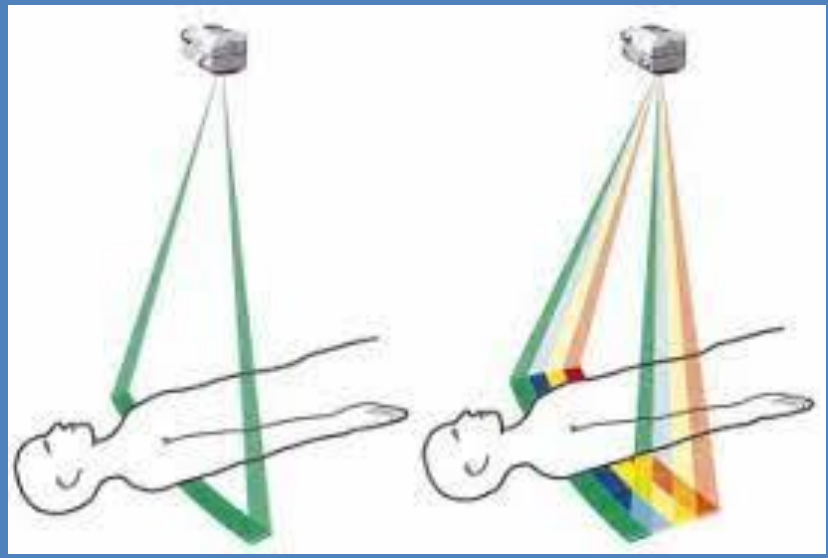


Machine's x-ray beam rotates around you.

7th generation CT

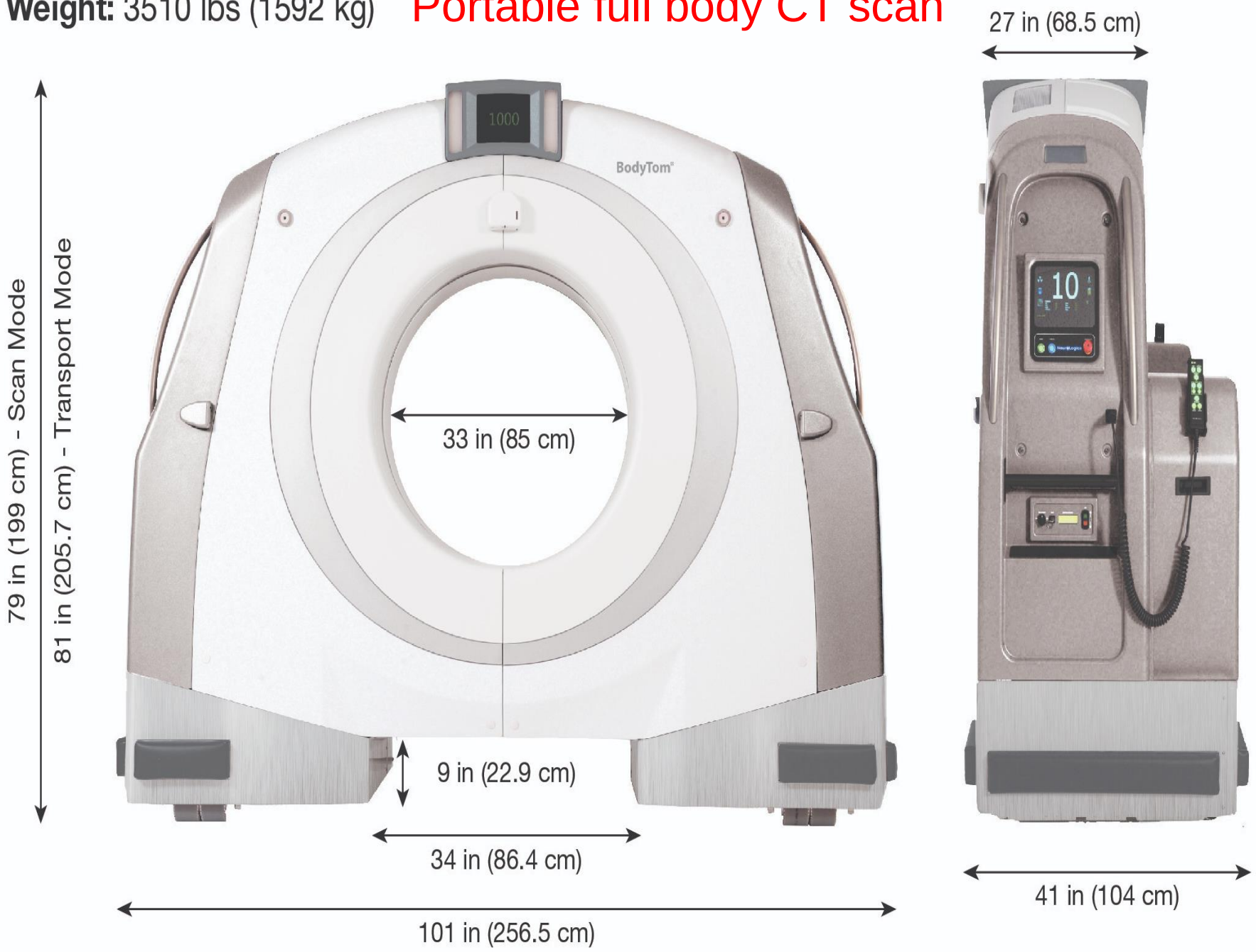
- Since 1998.
- Allow simultaneous acquisition of multiple slice in a single rotation.
- ½ sec rotation (0.5 sec).
- Sub-second scanner.
- 2001- 16 row spiral CT.
- 2007- 320-row spiral CT.

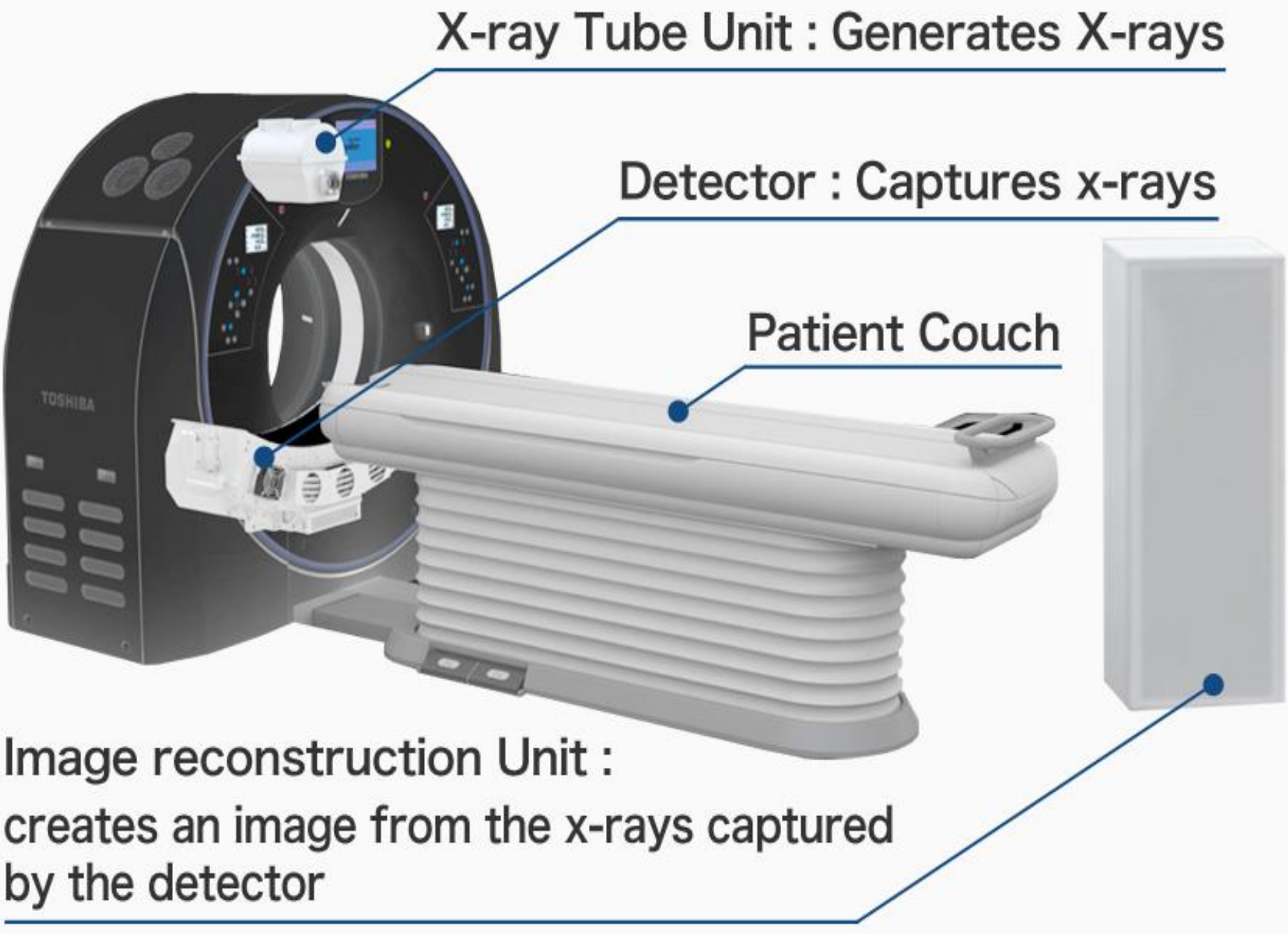




Weight: 3510 lbs (1592 kg)

Portable full body CT scan




X-ray Tube Unit : Generates X-rays
Detector : Captures x-rays
Patient Couch
TOSHIBA
Image reconstruction Unit :
creates an image from the x-rays captured
by the detector

Radiation exposure according to FDA

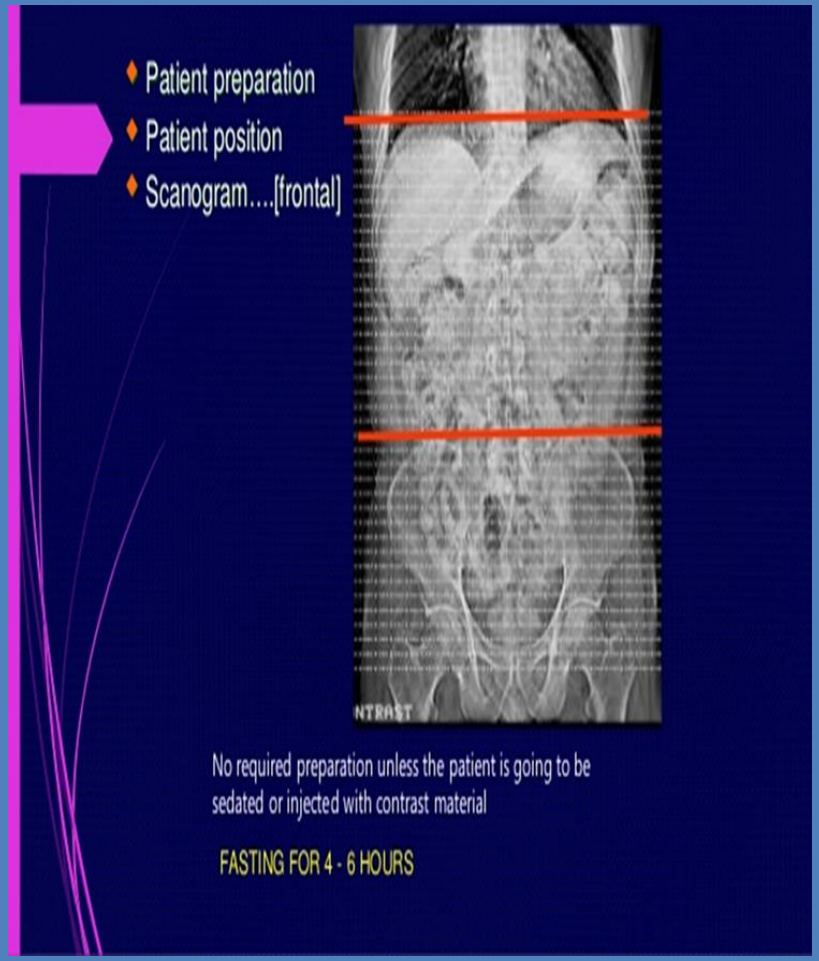
Procedure	Effective dose (msv)	No. of CXR for equivalent effective dose	Time period for equivalent effective dose from natural background radiation
CXR PA view	0.02	1	2.4 days.
Skull x ray	0.1	5	12 days.
Lumbar spine	1.5	75	182 days.
IV urogram	3	150	1 year.
Upper GI exam	6	300	2 year.
Barium enema	8	400	2.7 years.
CT scan of brain	2	100	243 days.
CT abdomen	8	400	2.7 years.
CT abdomen & pelvis	10	500	3.29 yrs.

Scientific unit of measurement for whole body---

- **radiation dose (effective dose)—millisievert.**

Preparation for CT scan

- History about comorbidities, allergy etc.
- Drink plenty of water before & after.
- Removal of unnecessary metallic objects, jewellery, drug delivery patches.
- No required preparation unless pt. is sedated or injected contrast.
- Premedications (allergy cases).
- Fasting 4-6 hours.



Must be still during exam.

Movement- produce blurred images.

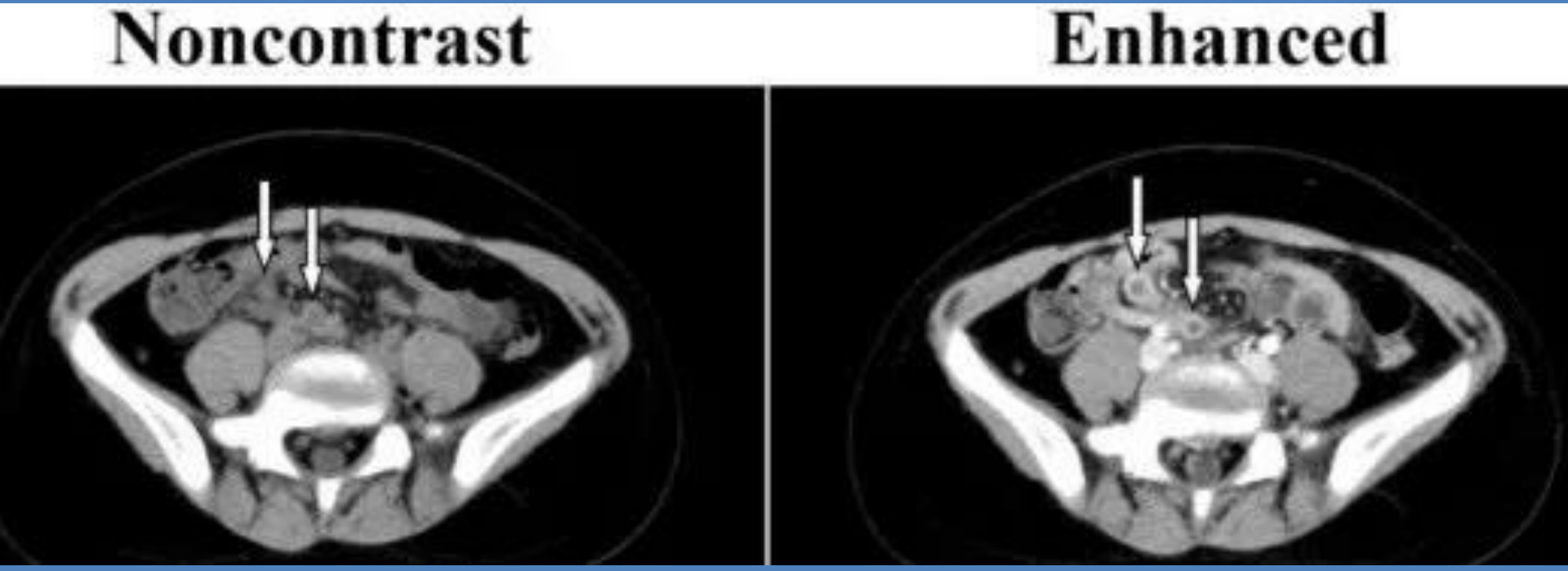
Hold your breath for short period of time

Multislice CT

- *CT images are 5 mm slices.*
- *Soft tissue window view settings.*

Types of CT on the basis of contrast

- Non contrast.
- Contrast enhanced.



Types of contrast/ Dye
Enhanced / not.

- Oral-(1-2 hrs)-
    - Barium sulphate.
    - Gastrographin.
- Intravenous.(50-70sec)-
    - Iodide.
    - Gadolinium---MRI.
    - Eliminated by kidney & liver.
- Rectal (immediately).
- Intra-articular.

Typical circulation times-

- Arm vein to arm vein (total circulation time) - 25 (22-28 secs).
- Arm v. to face - 24 secs.
- Pulmonary circulation time - 6 secs.
- Arm v. to heart - 4 secs.

Basics

Non contrast study.

Contrast study-

- 100 ml contrast @ 3 ml/sec.
  - Arterial phase- 20-40secs.
  - Portal venous phase- 60-80 secs.
  - Early delayed phase-
    - >180 secs, best at 4 mins.
  - Late delayed phase- 4-6 hrs.

Nephrogenic phase -

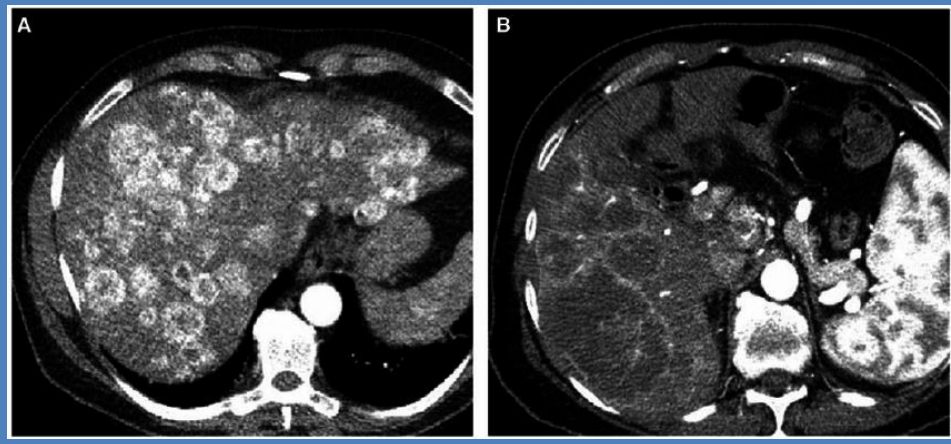
- 80-100 sec
- Kidney tumor,
- Renal trauma.

Equilibrium/ delayed phase –

- 6- 10 min.
- Ureteral obs.
- Ureter leak,
- characterization of liver tumor.

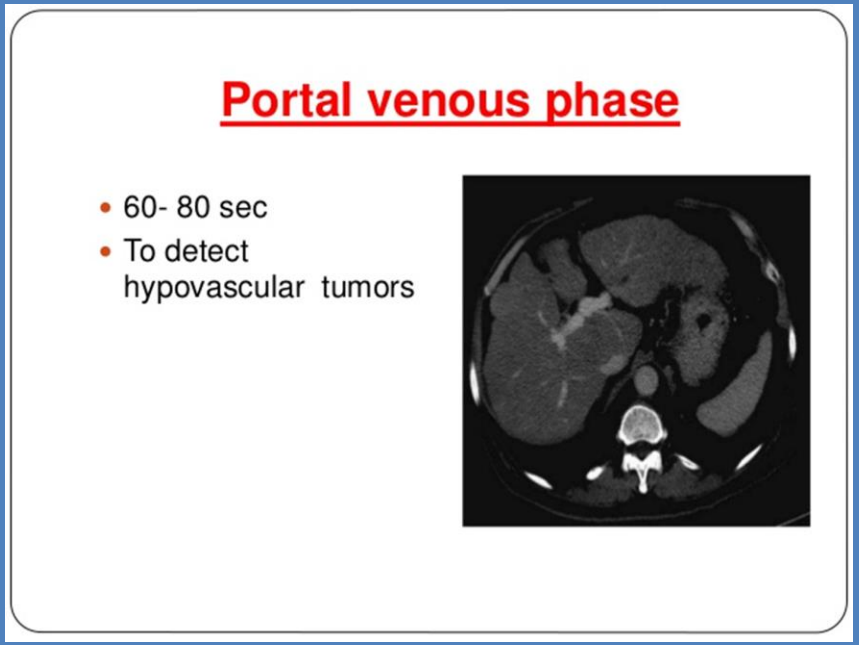
Arterial phase

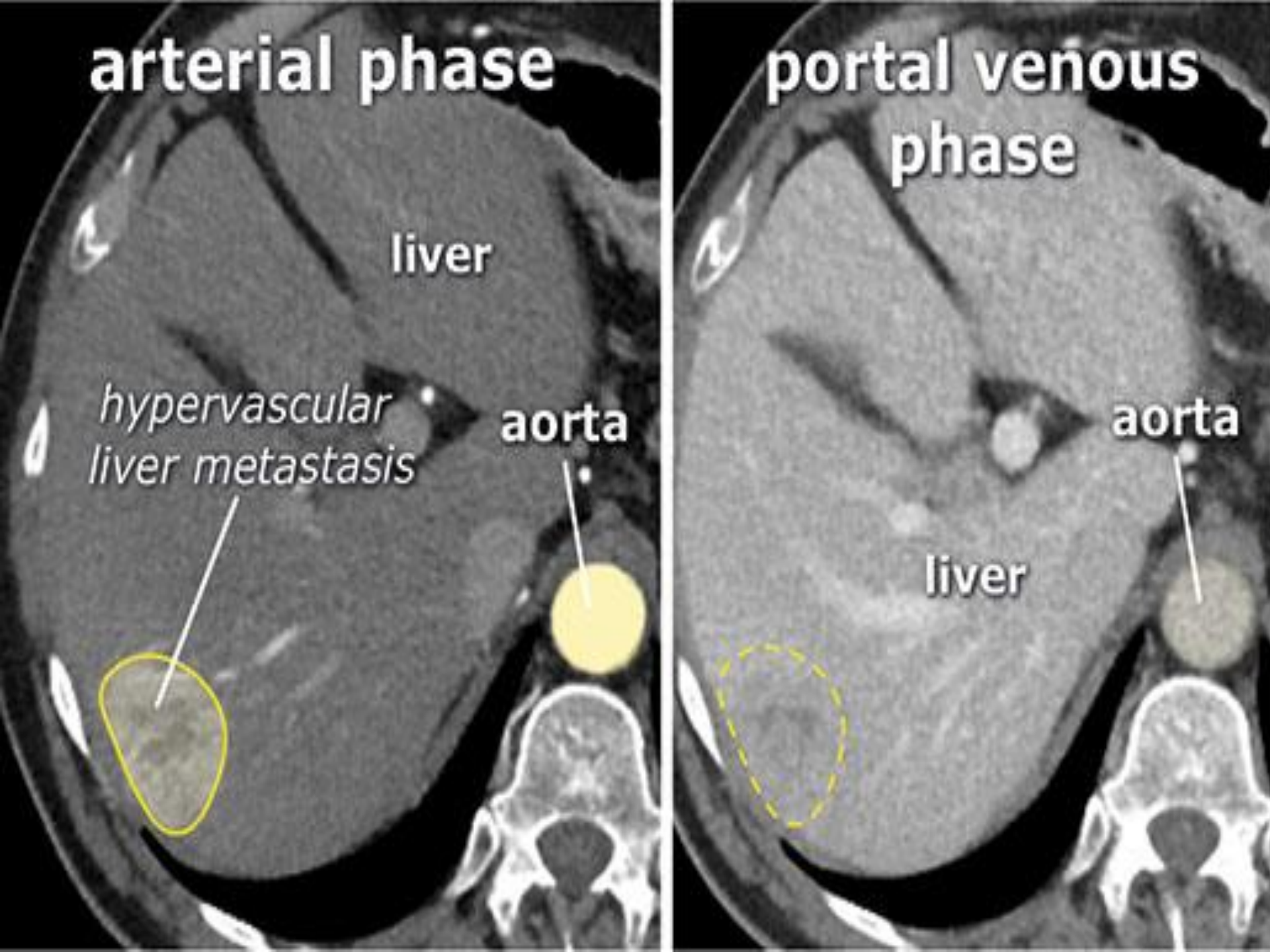
- 20-40 secs.
- Normal liver parenchyma not yet enhanced.
- Hypervascular liver tumor enhance via hepatic artery.
- Hypervascular tumors enhance optimally at 35 secs.
- Hypervascular metastasis-
    - Breast.
    - Sarcomas.
    - Neuroendocrine tumors.
    - RCC.
    - Melanoma.

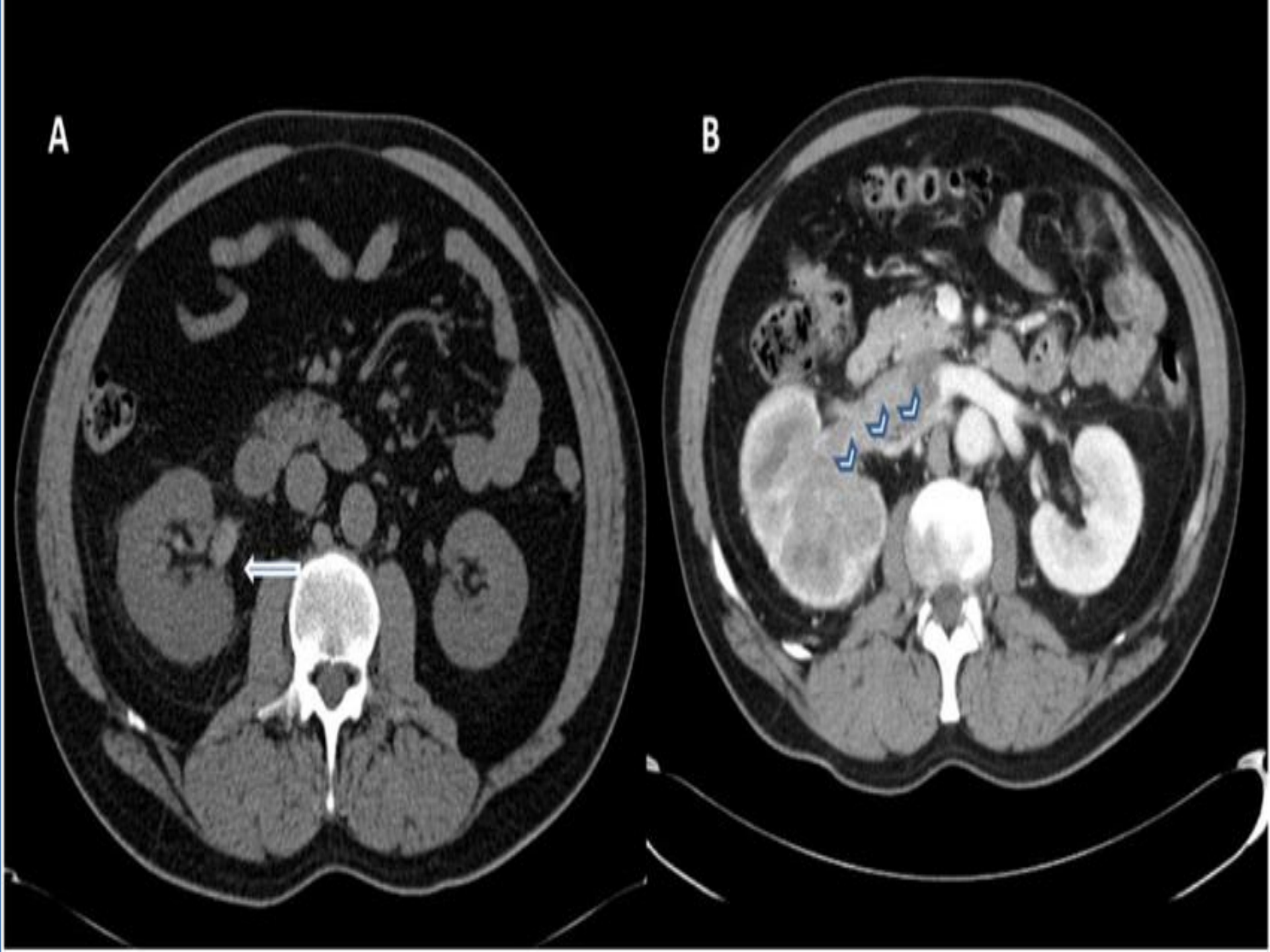


Portal venous phase

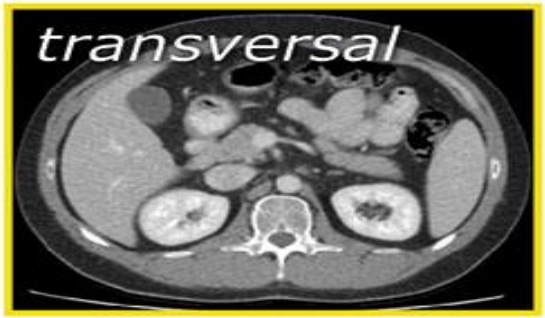
- 60-80 secs.
- Detect hypovascular tumor.
- Hypovascular metastasis-
    - Colorectal cancer.

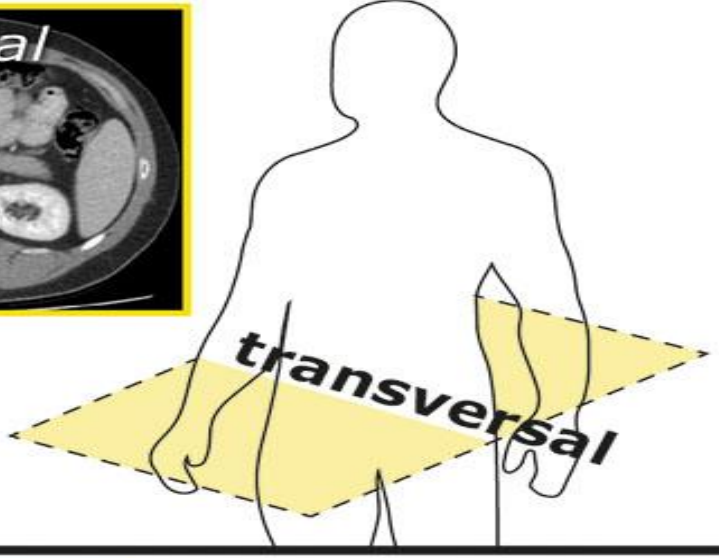


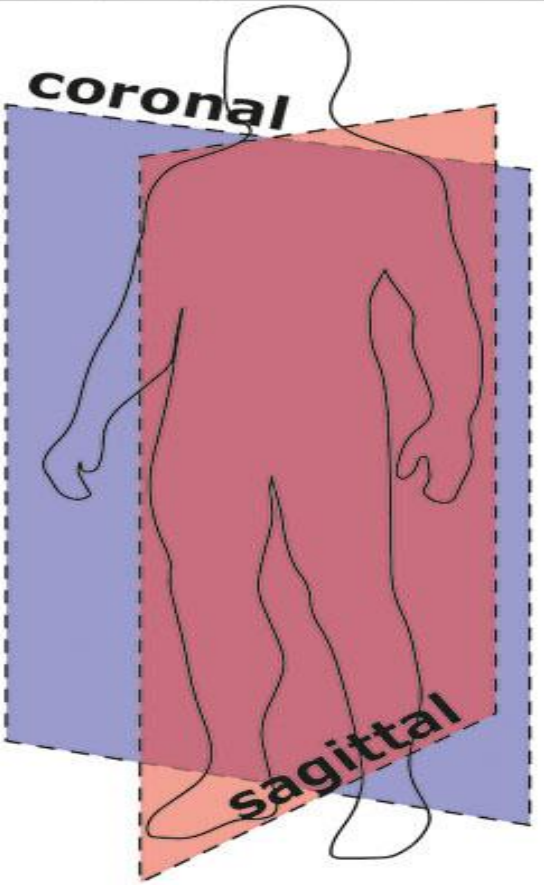

arterial phase
liver
hypervascular
liver metastasis
aorta
portal venous
phase
aorta
liver


A
B

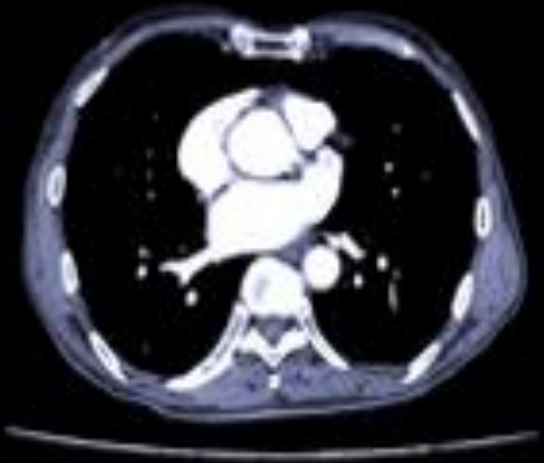
- Axial.
- Coronal.
- Sagittal.





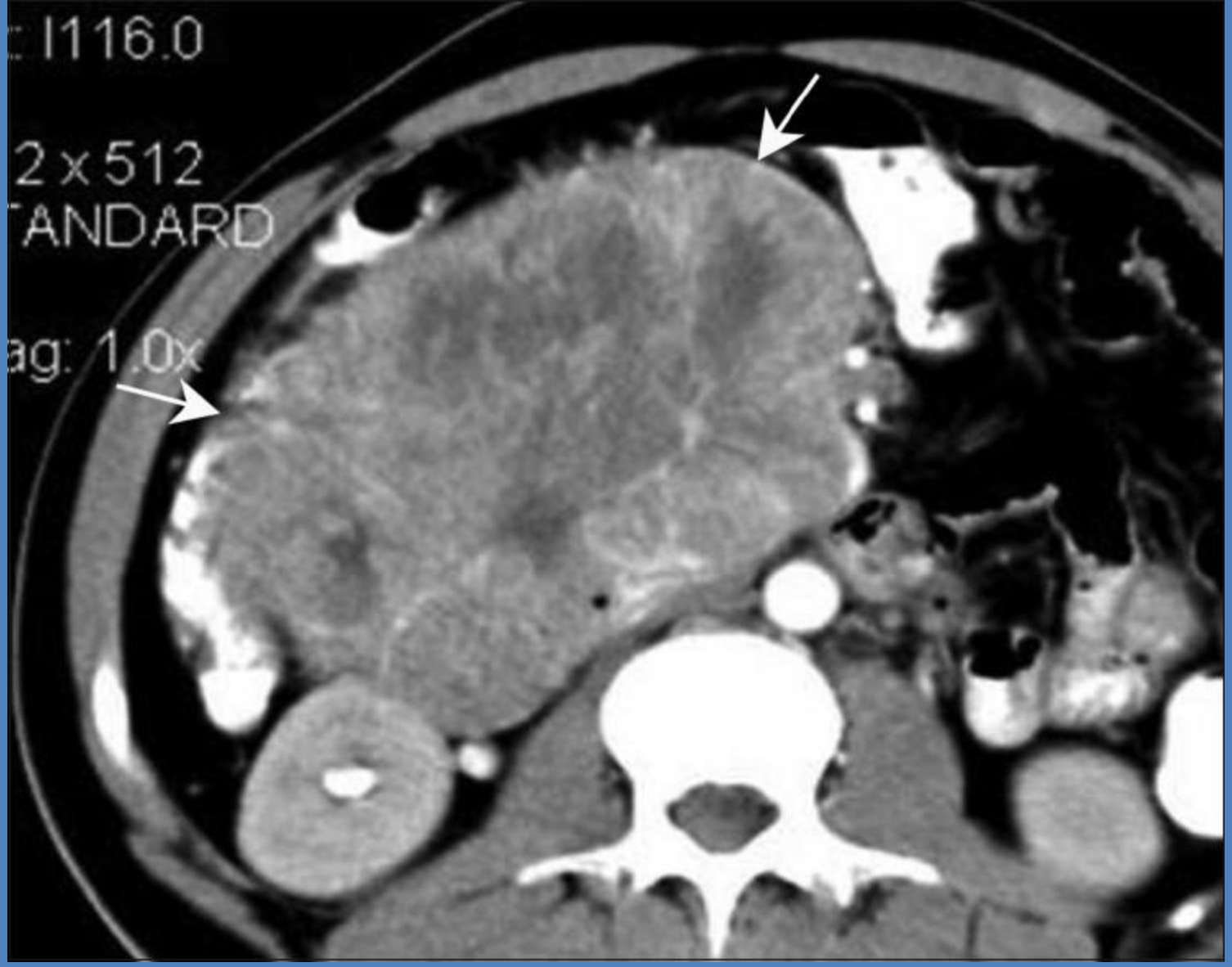


CT whole abdomen

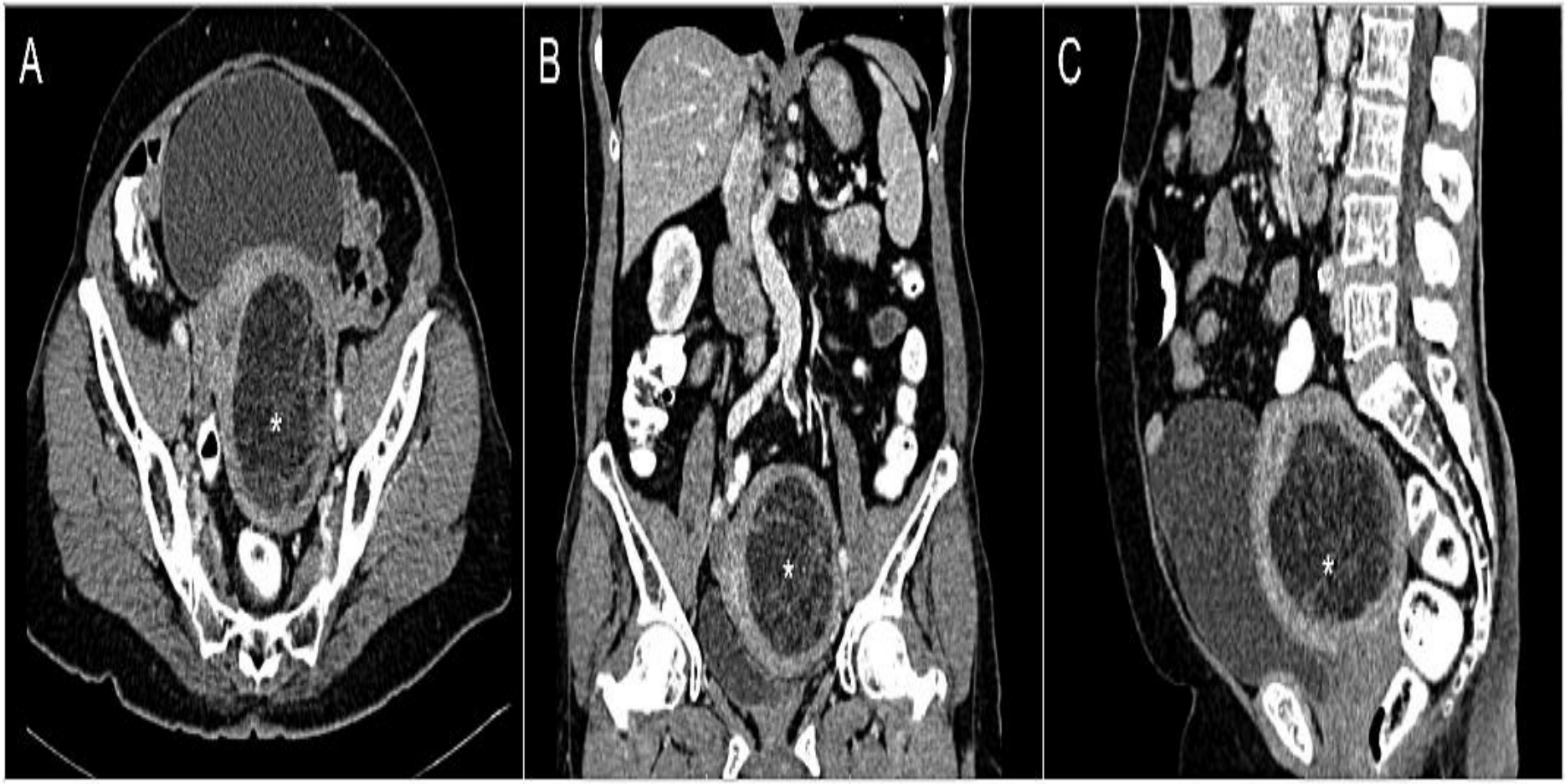


Density –

- Isodense.
- Hypodense.
- Hyperdense.
- Mixed density.



Duodenal GIST- Axial contrast-enhanced CT scan in a 35-year-old female show a well-defined heterogeneously enhancing mass (arrow) along the second part of the duodenum



Images are viewed from the feet. So organization is-

Right **Left**

Planes of the abdomen

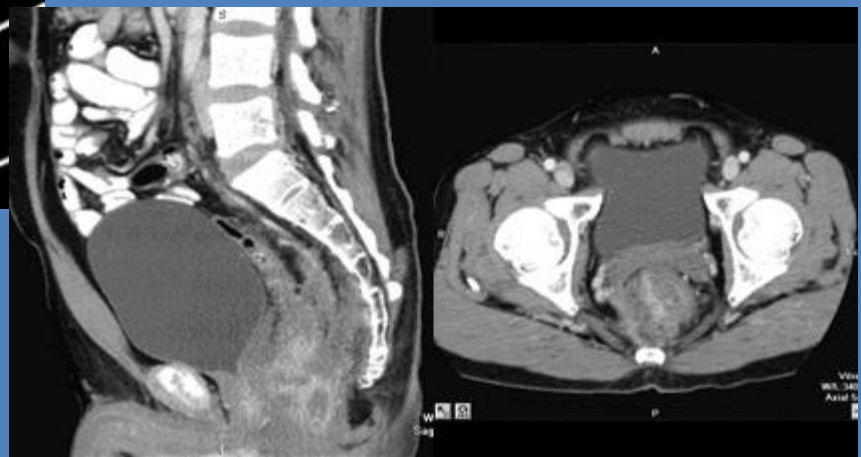
- Transpyloric plane- L1.
- Subcostal plane-L3.
- Transumbilical- L3-4.
- Transtubercular-L4.
- Midline plane.
- Midclavicular.

Role of CT scan

- Diagnosis of primary disease.
- Assess the involvement of surrounding structures.
- Locoregional spread.
- Distant spread.
- Resectability of primary tumor.
- Response to treatment.
- Recurrance of tumor.
- Extra hepatic metastasis.

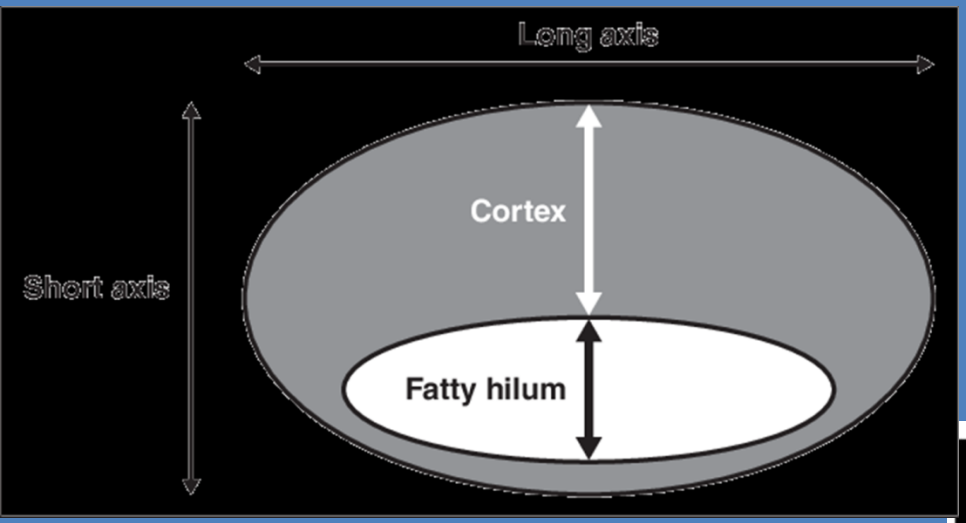

a)
b)
A
c)
L

Attenuation of fat plane

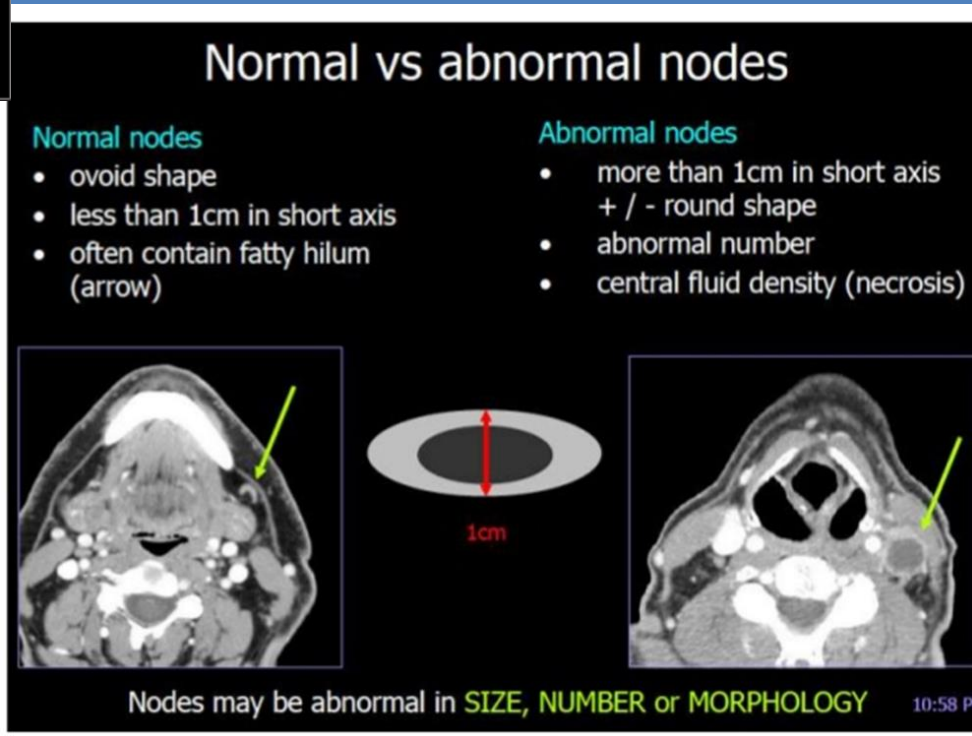


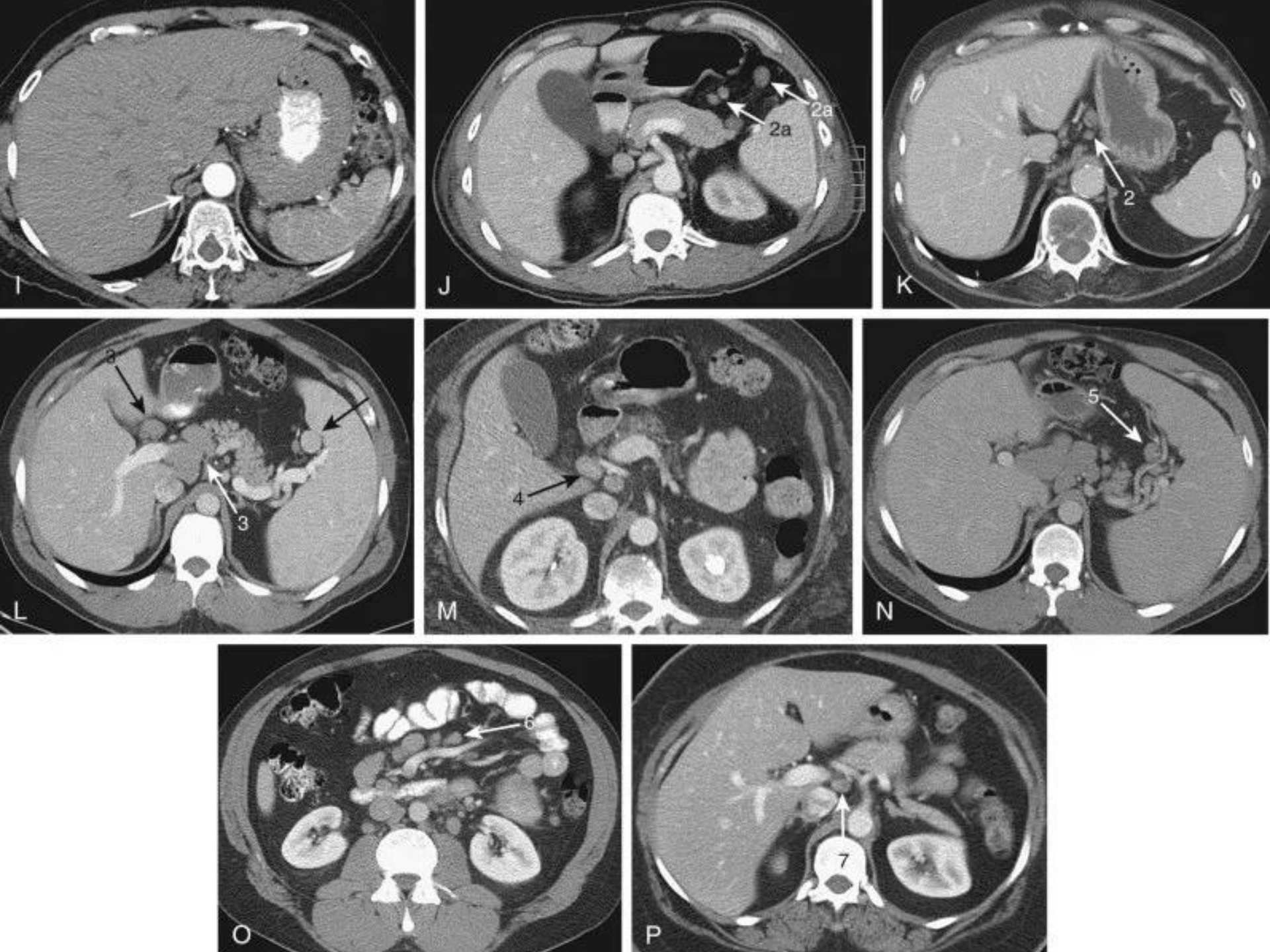

2 cm
venos 5-0 B30f

Metastatic LN



- >1 cm in short axis.
- +/- round shape.
- Abnormal number.
- Central fluid density.




I
J
2a
2a
K
2
L
3
3
M
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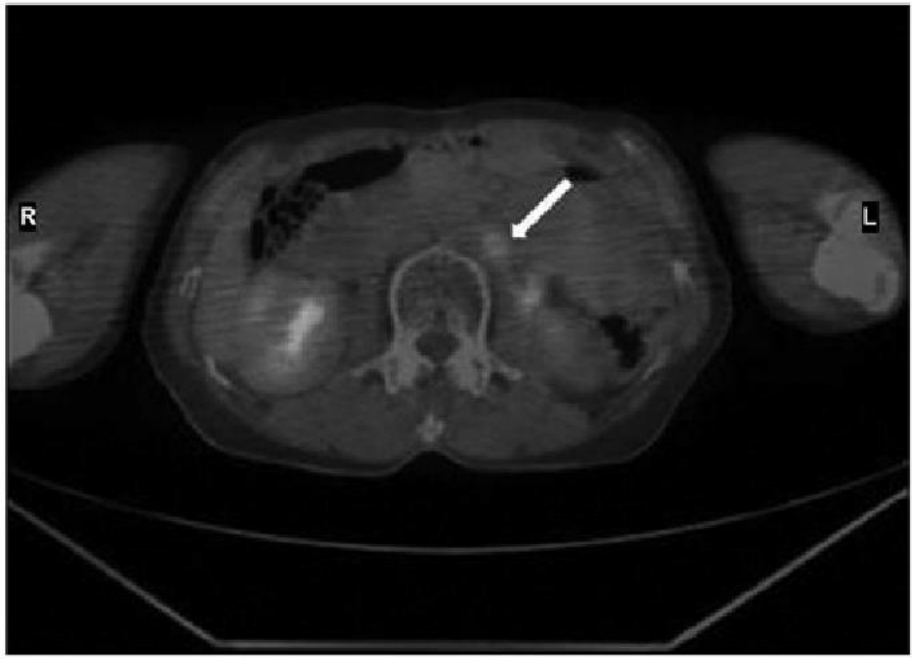
N
5
O
6
P
7

CT scan revealed-

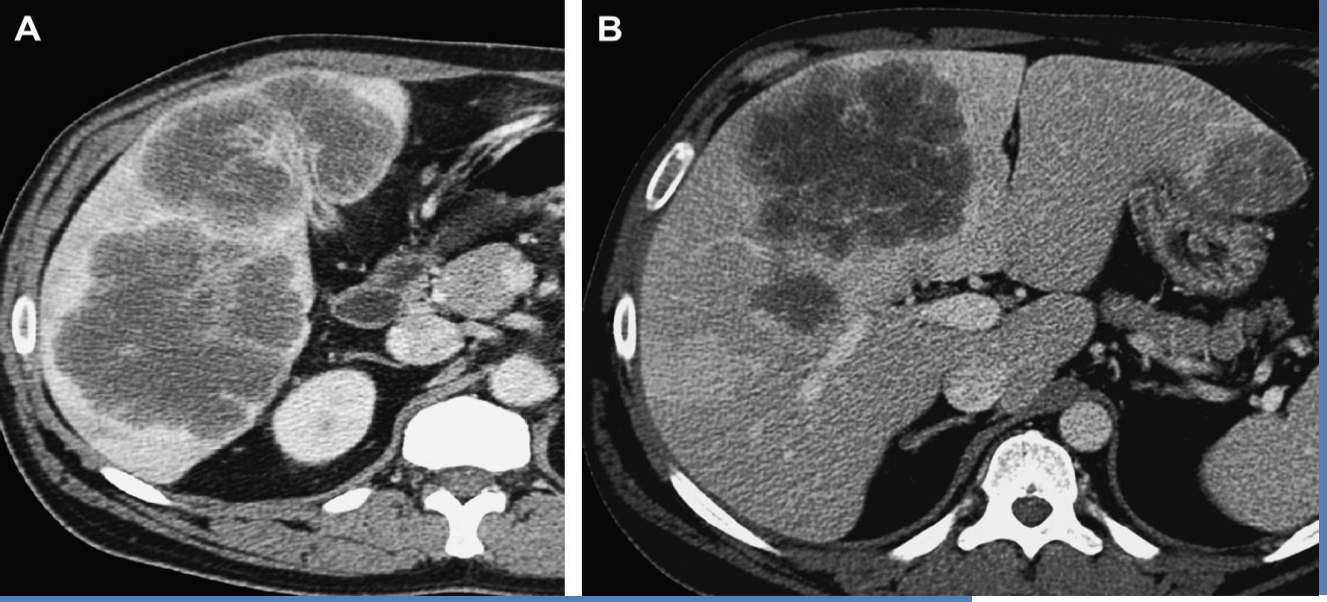
- Swollen lateral paraaortic LN (white arrow).

- FDG-PET / CT- hypermetabolism in the lateral paraaortic LN (white arrow).



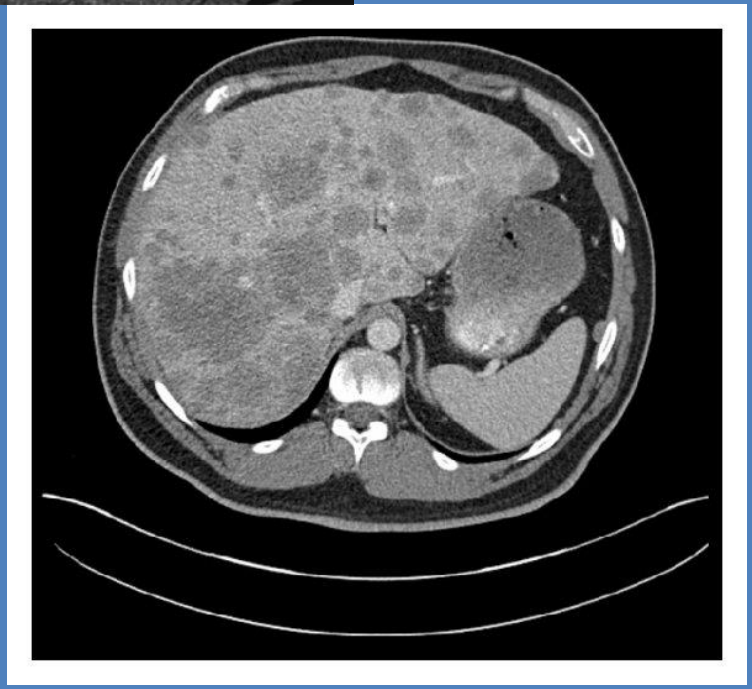
Colorectal Liver metastasis

- In 30% of curative resection there is occult liver metastasis.
- Only 15-25 % present at the time of diagnosis- Synchronous.
- Additional 20-25 % develop Metachronous liver tumor.
- In 30% liver is the only site of metastatic disease.



Majority of liver metastasis are

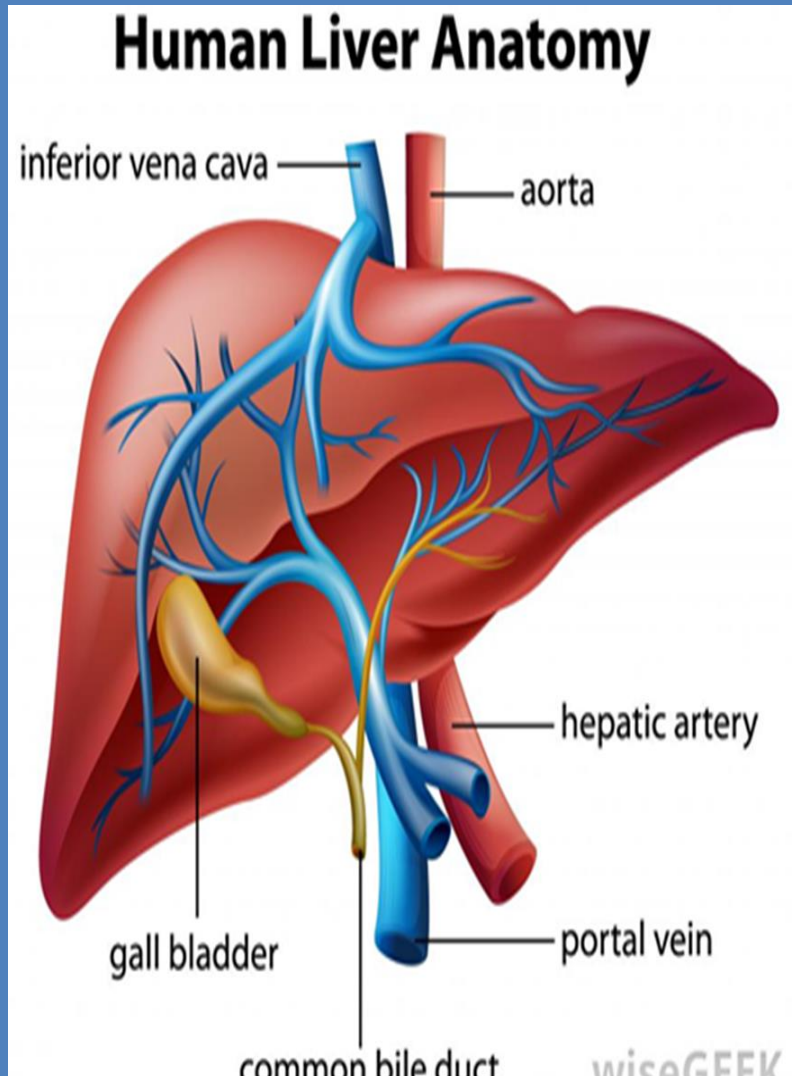
- Hypodense as hypovascular.
- More hypodense in CECT.
- Best depicted during portal venous phase.
- Hypoattenuating compared with surrounding parenchyma.



Innumerable liver metastases with colorectal cancer & the primary mass in the ascending colon.

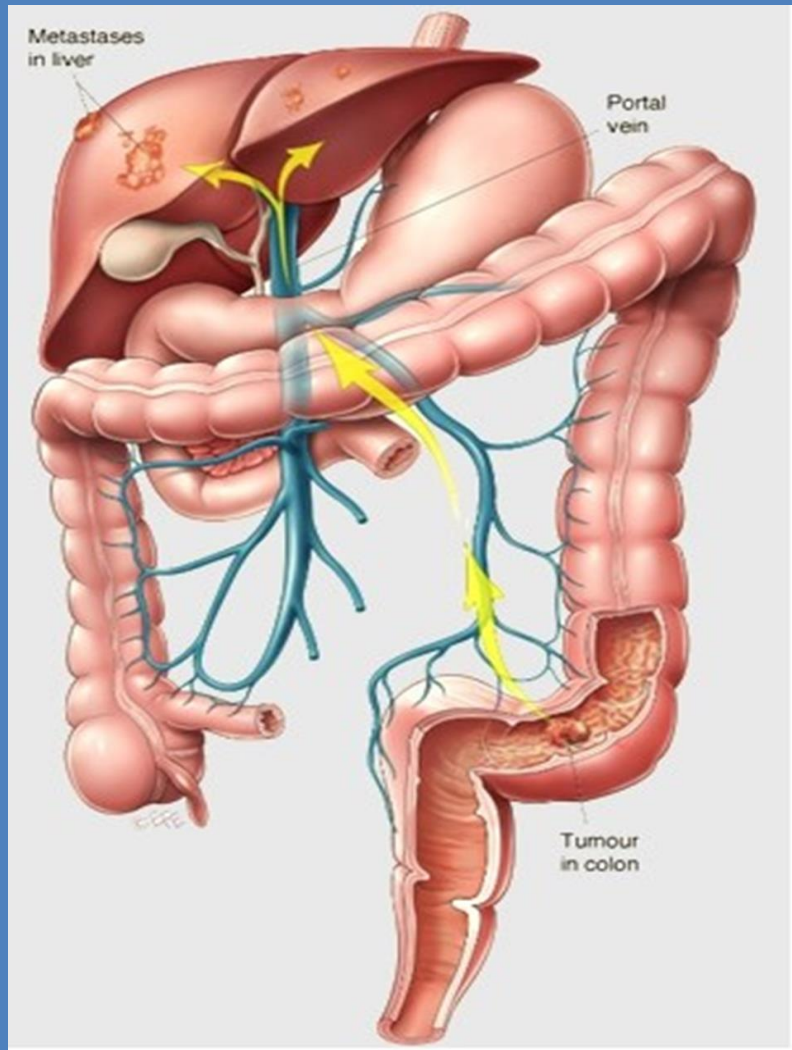
Blood supply

- Dual blood supply.
- Normal parenchyma-
  - 80% portal vein.
  - 20% hepatic artery.
- All liver tumors-
  - Hepatic artery.



Which lobe is more involved?

- Right colon to rt lobe 10 times than the left.
- Left colon & rectum distribute homogenously.



Hypervascular metastasis

- Hypervascular metastasis-
    - Breast.
    - Sarcomas.
    - Neuroendocrine tumors.
    - RCC.
    - Melanoma.
- 20-40 secs.
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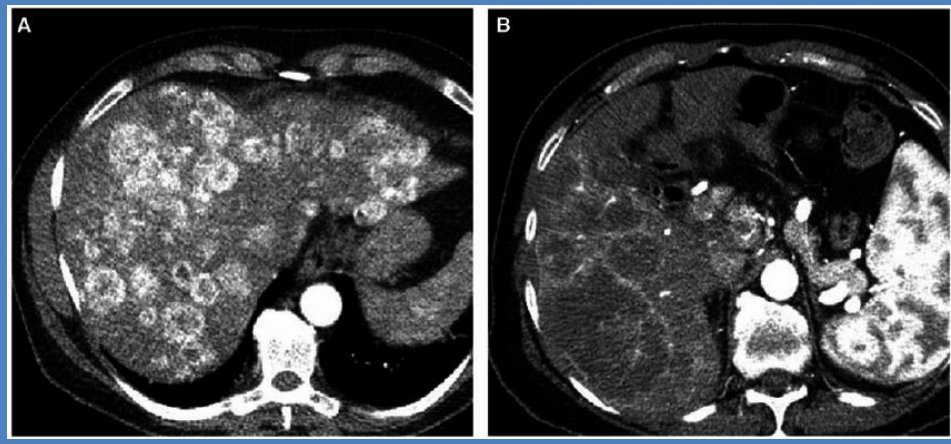
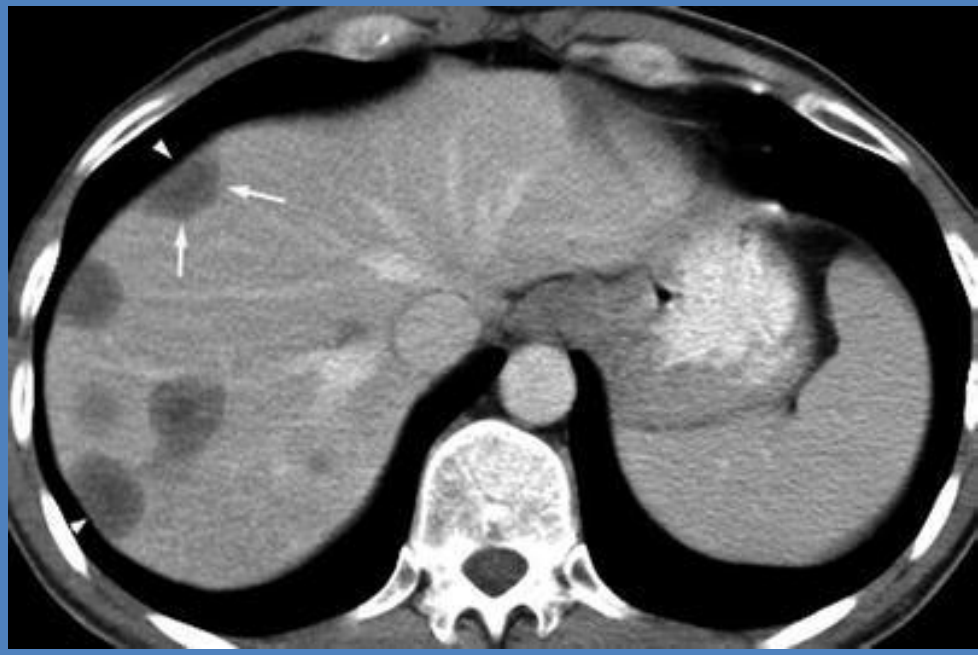


Hypovascular metastasis

- Hypo vascular metastasis-
  - Colorectal cancer.
- 60-80 secs.
- Portal venous phase.
- Detect hypovascular tumor.



Calcified liver metastasis

- Mucinous GI tumor.
- Ovarian cancer.

Calcified liver metastasis from colon cancer

Colorectal Cancer

CT Findings

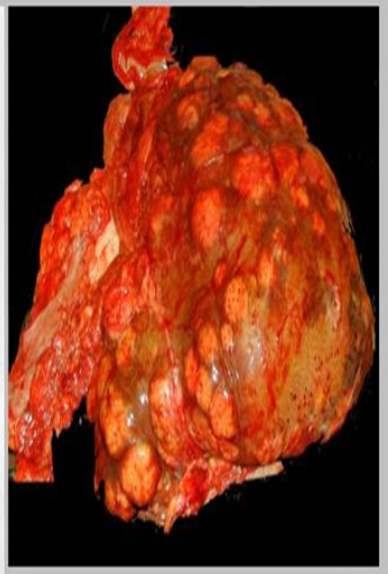
Non contrast-

- Isodense / hypodense.

CECT-

- Best on portal venous phase.
- Less enhanced than surroundings.
- Slight peripheral enhancement with a hypoattenuating center.

Contrast-enhanced CT showing **liver metastases.** Several low-density metastases involve both lobes of the liver.



Numerous metastases. The tumor cells were arranged in nodules and occupied approximately 90% of the hepatic parenchyma.

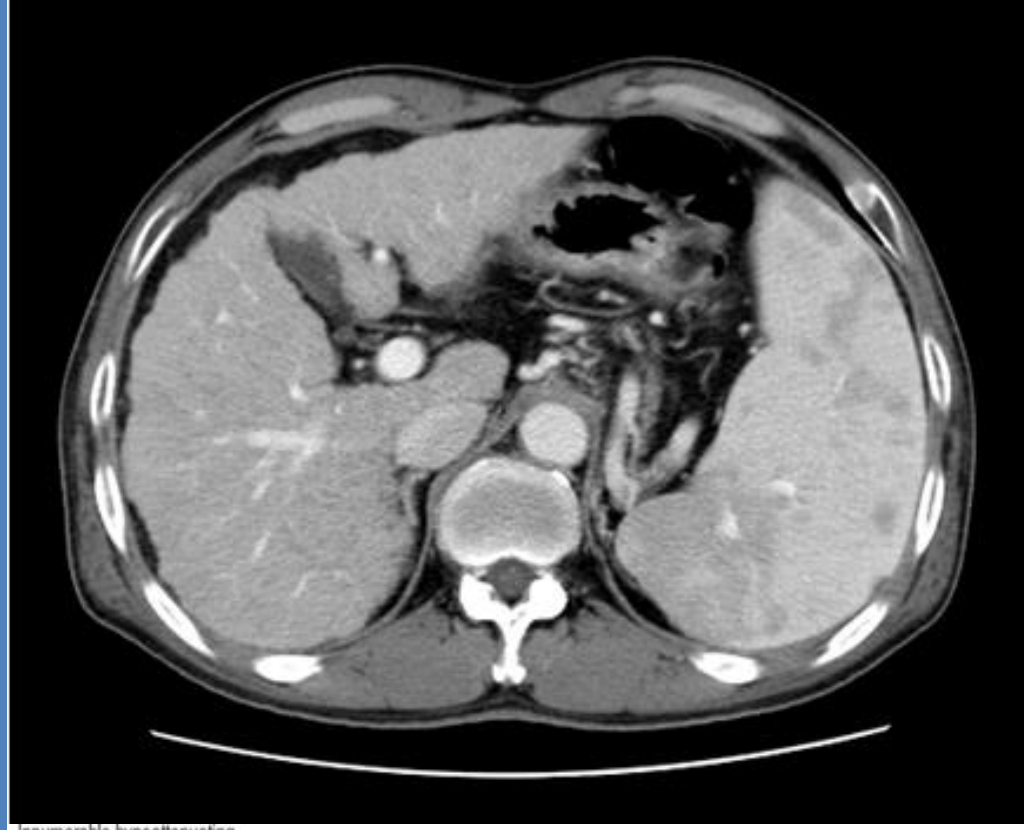
CLD

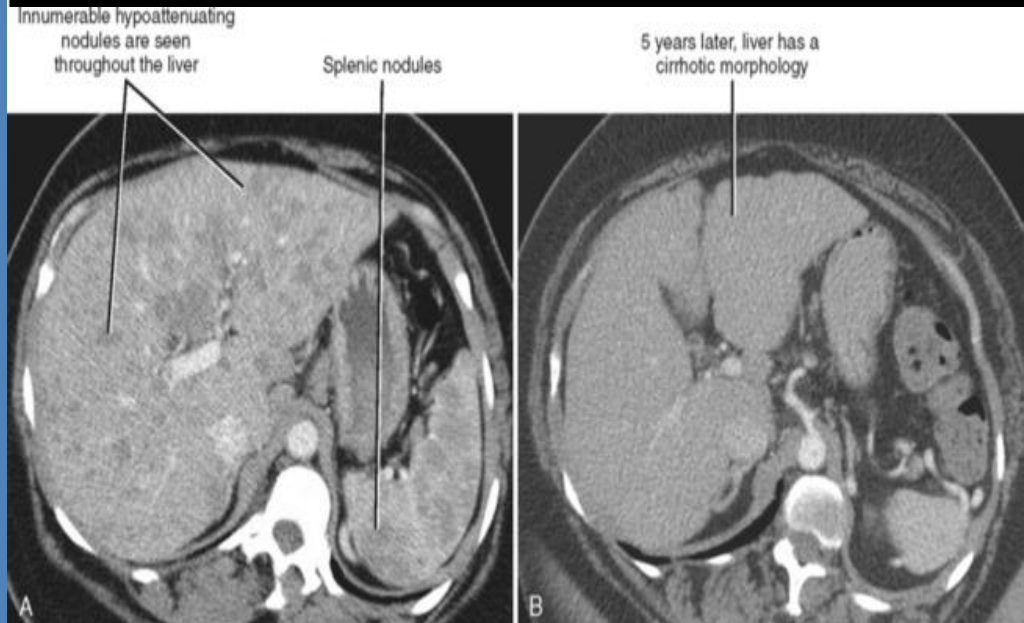
Portal venous phase-

- Atrophic liver.
- Irregular in external contour.

- Others-

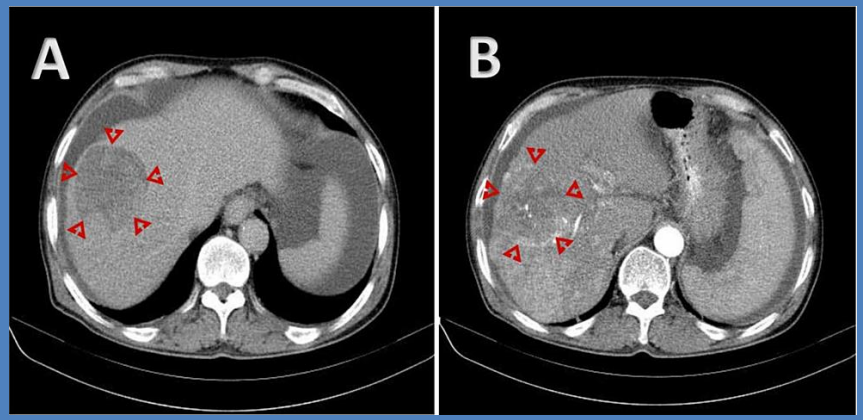
  - Thickened gallbladder wall.
  - Splenomegally.
  - Numerous collaterals within omentum.
  - Ascites.





Hepatocellular carcinoma.

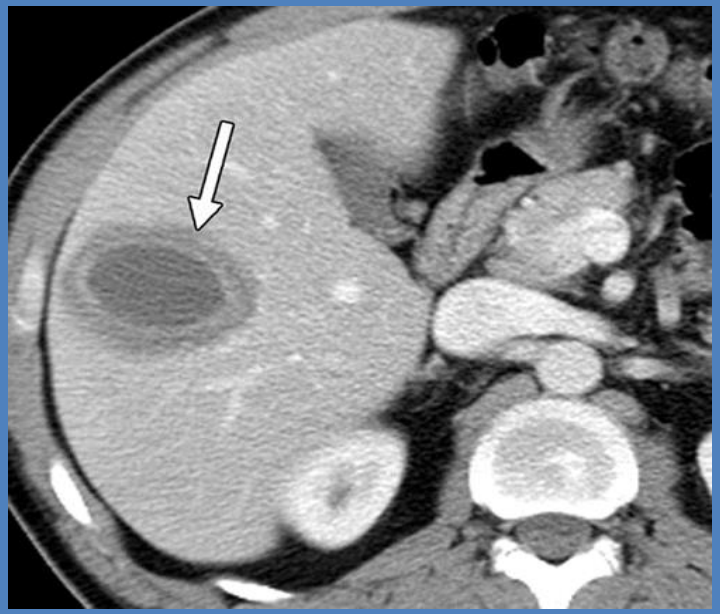
- Single or multiple masses.
- Hypodense to normal liver.
- Calcification may be seen.
- Arterial phase- Very early arterial perfusion.
- Portal phase- contrast washout.

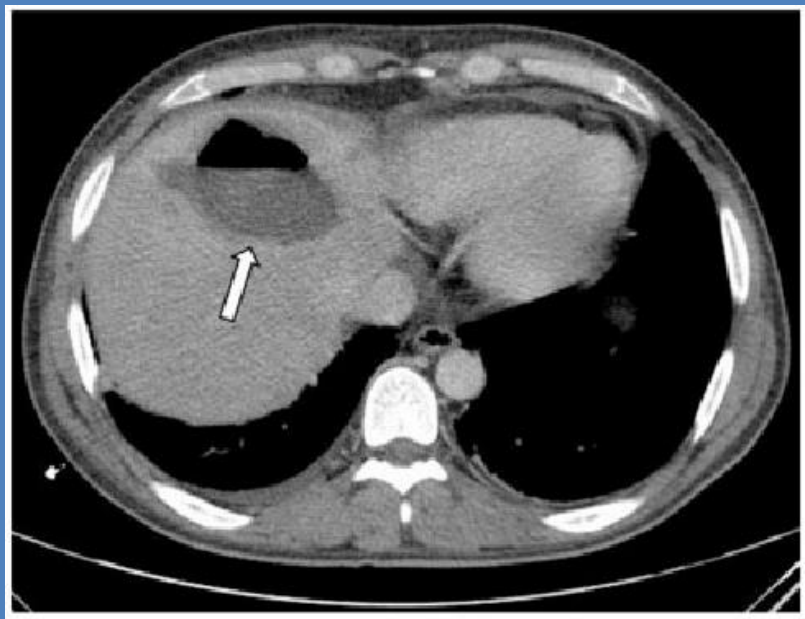


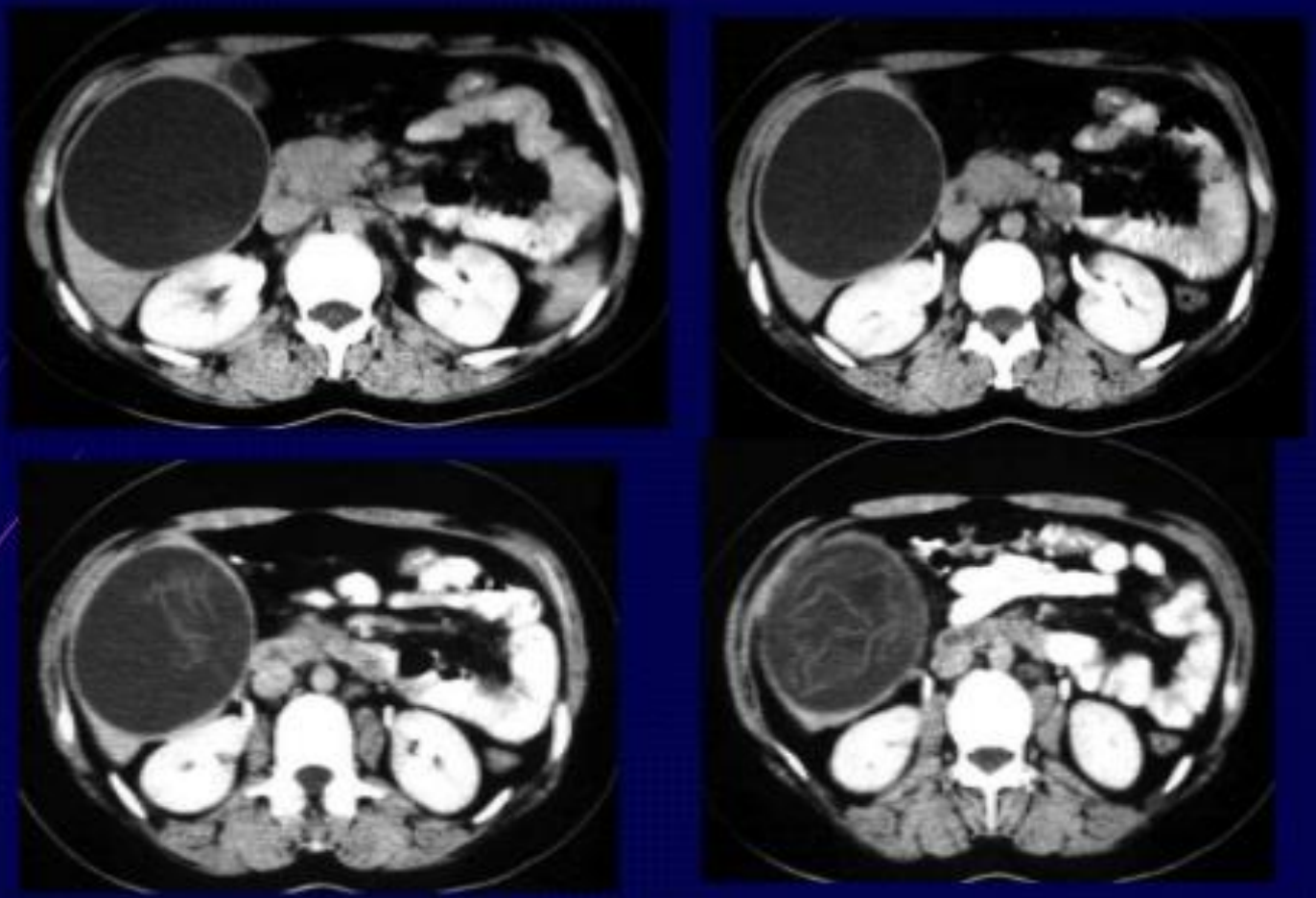
CT imaging showing a mass in a cirrhotic liver with mosaic enhancement on early phases and rapid washout on delayed phase, compatible with hepatocellular carcinoma

Hepatic abscess

- Variable.
- In general-
  - Peripheral rim enhancement.
  - Centrally hypoattenuating.
- Occasionally-
  - Solid or
  - Contain gas (~20% of cases).
  - The gas may be in the form of bubbles or air-fluid levels



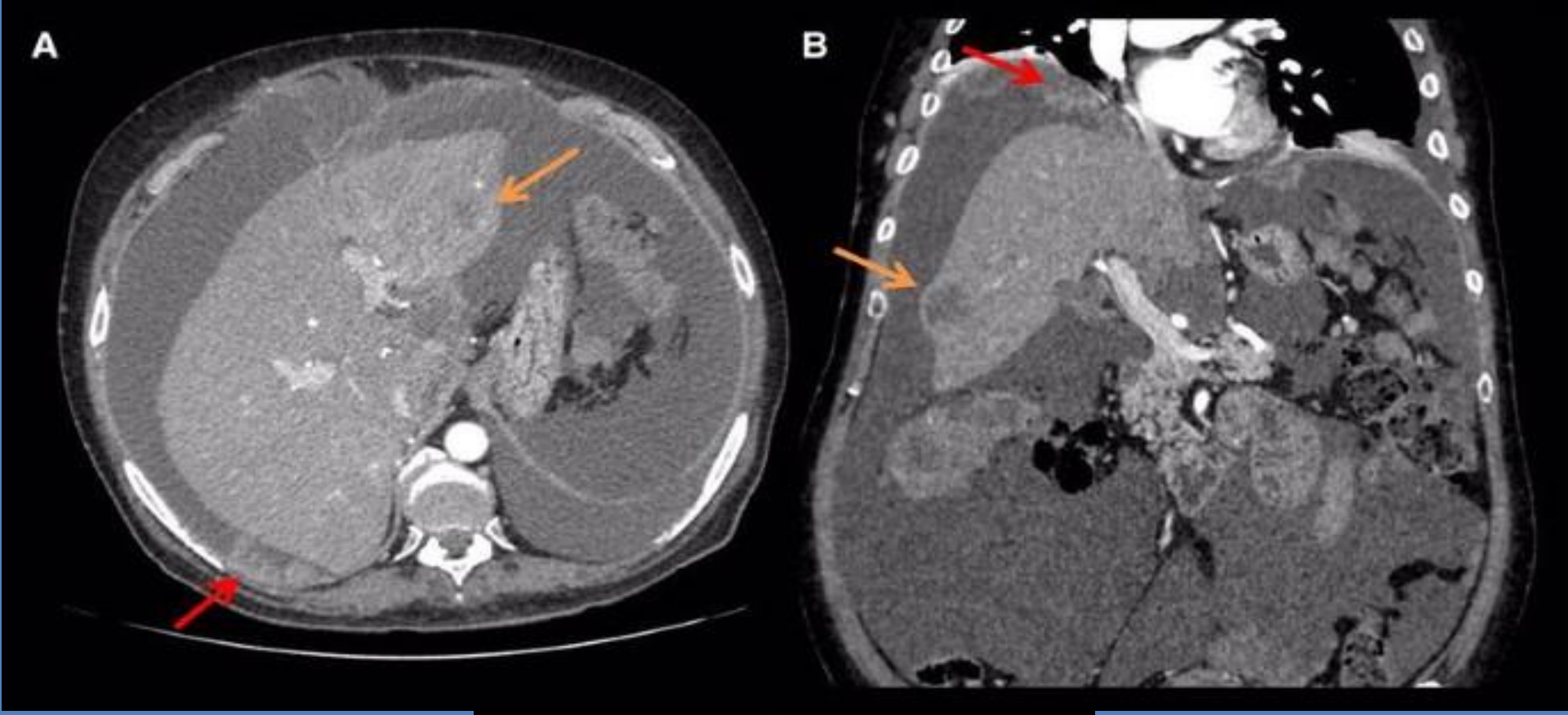




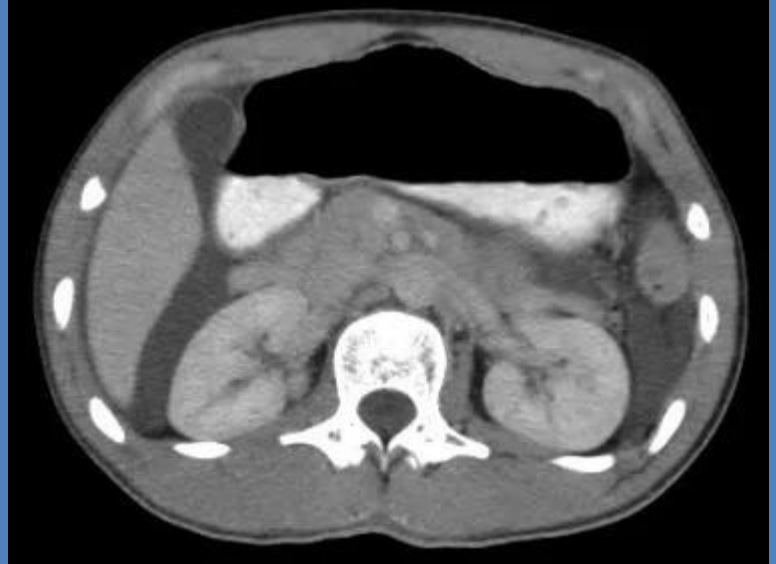
Hydatid cyst

Active hydatid disease-

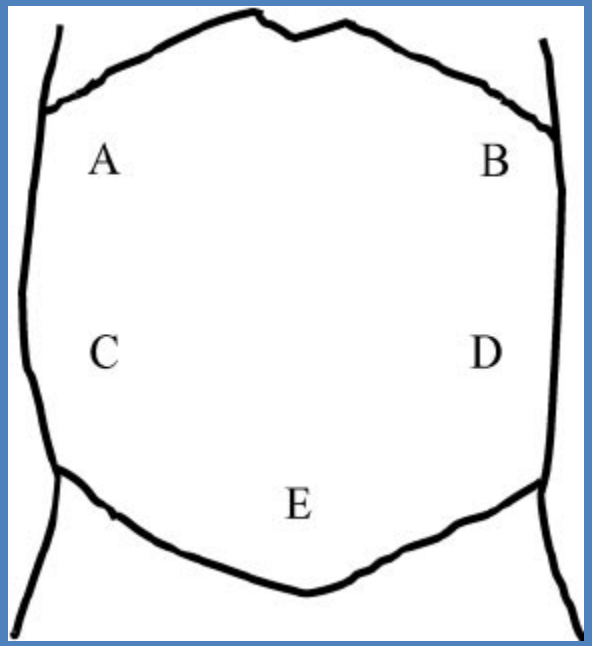
- Usually non calcified liver cyst.
- Floating layers of germinal membrane within the cyst.



Ascites



Quantification of ascites by using 5 point study



Root of SMA

Lower pole of left kidney

Root of femoral artery

- The following equation was used to calculate the volume of ascites: (A+B+C+D+E) × 200 ml.

- ascites volume >300 ml.
- Minimal- 25-50 ml.
- Mild- 50-300ml.
- Moderate-upto 1 litre.

Traditional principle of resection for CRC liver metastasis.

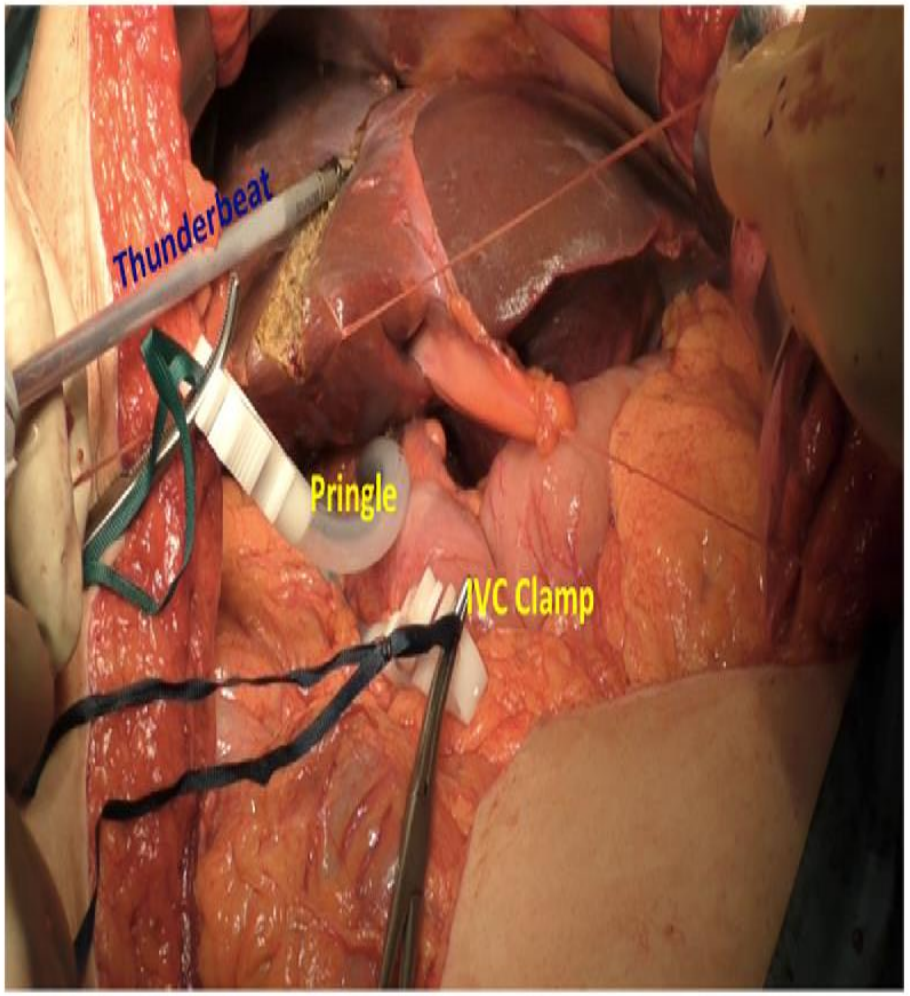
- Unilobar.
- <4 lesions.
- <5 cm in greatest dimension.
- Without extrahepatic disease.
- Well confined primary lesion.

Nowadays more resection is possible due to-

- > effective systemic therapy.
- Ablative therapies.
- > modalities for downstaging.

Traditional principle of liver transection

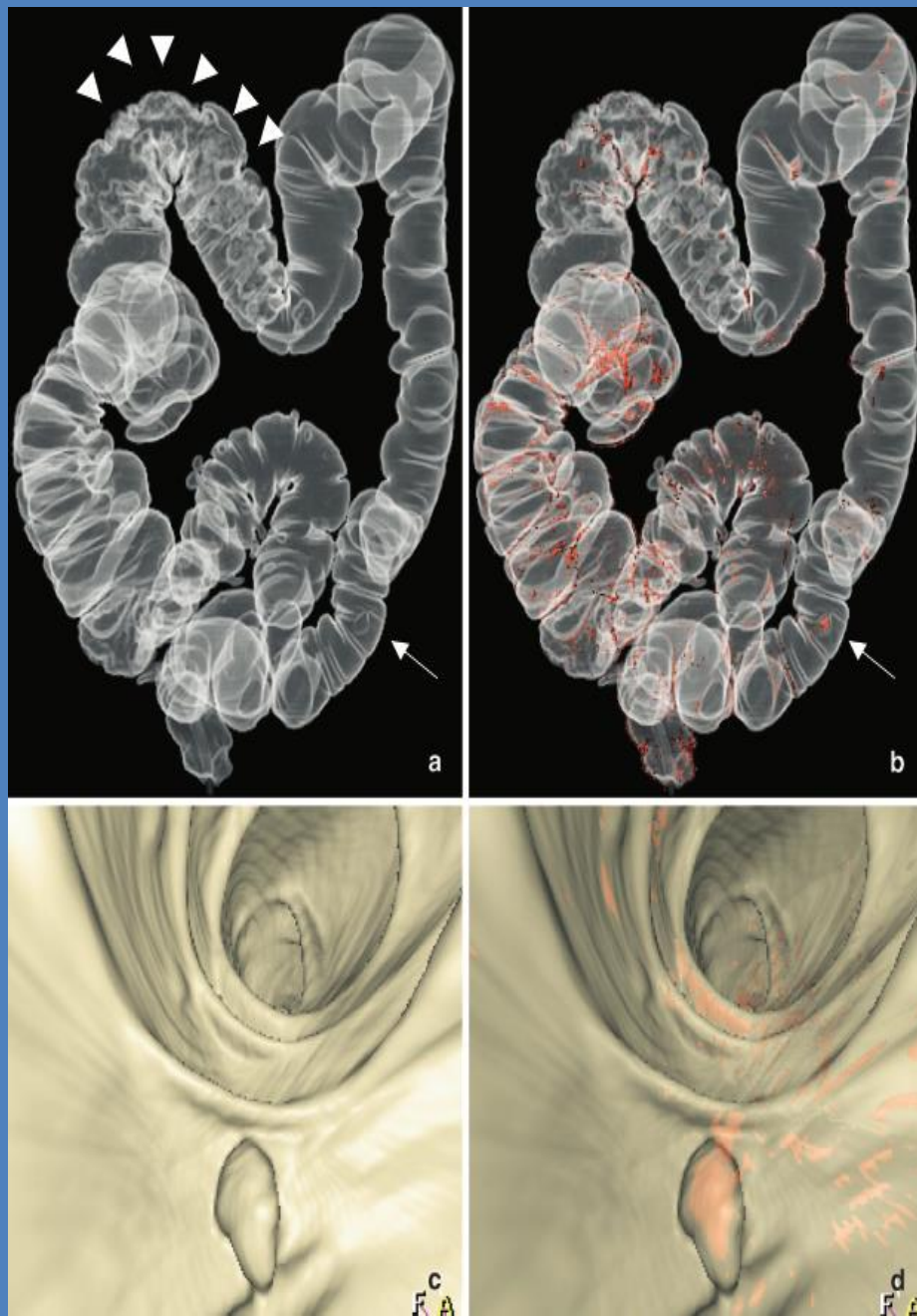
- Unilobar disease.
- <4 lesions.
- <5 cm in greatest dimension.
- Without extra hepatic disease.
- Unilobar / bilobar whatever might be the no. of lesion or size if there is resectable extrahepatic metastasis & good control of primary site…..



technique of parenchymal transection with TB | iver parenchyma being divided using TB in a pa

Virtual colonoscopy-

- CT colonography / CT pneumocolon.
- Non invasive procedure.
- Uses x-rays & computer.
- 2D & 3D images of colorectum.
- May provide 3D endoluminal views of the bowel.



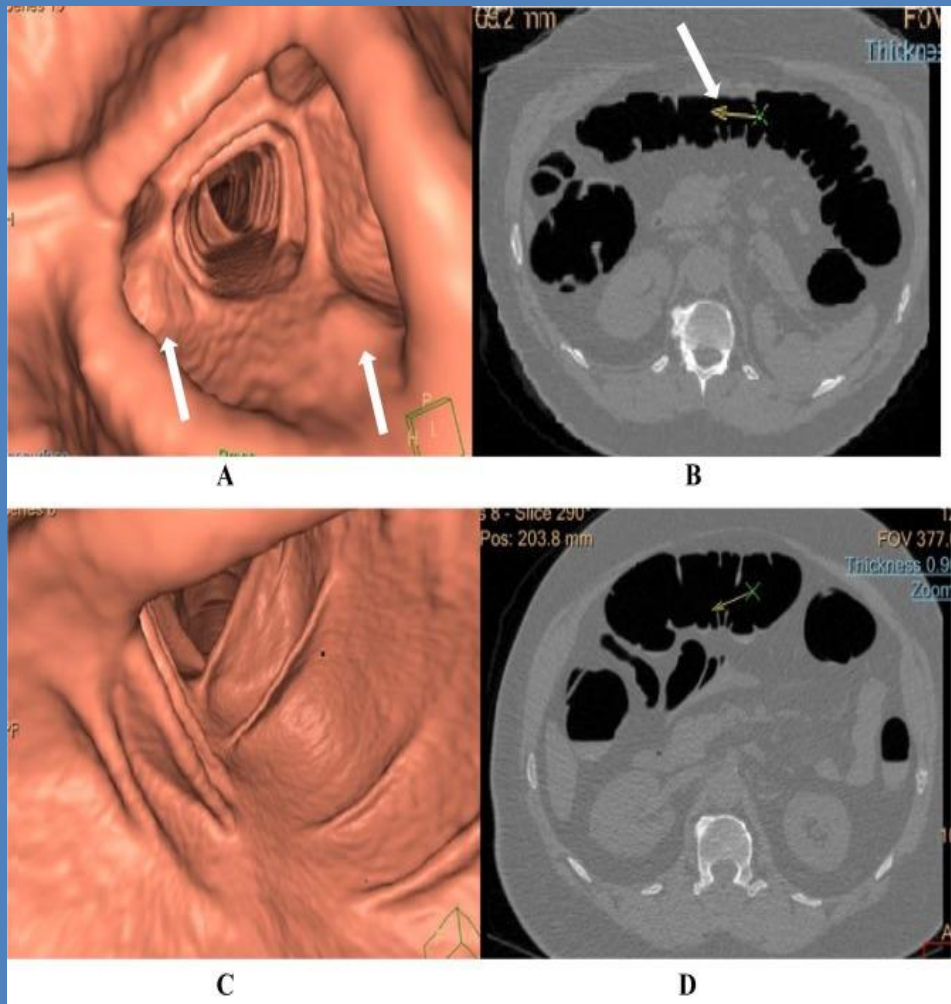
CTC

Preparation-

- Low residual diet- 24-48 hrs.
- Only fluid for 24 hours.
- Oral contrast-48 hrs.
- No sedation.
- Rectal gas- air or Co2.
- Supine/ prone.
- 6-7 secs acquisition time.

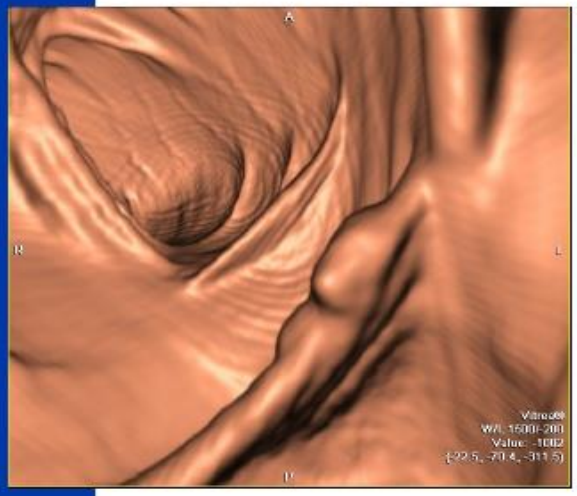
Advantages-

- Superior to DCBE.
- Non invasive.
- Sensitivity >90% for polyps >10mm.
- Well tolerated.
- Both intra & extraluminal information.
- Shorter exam. Time.

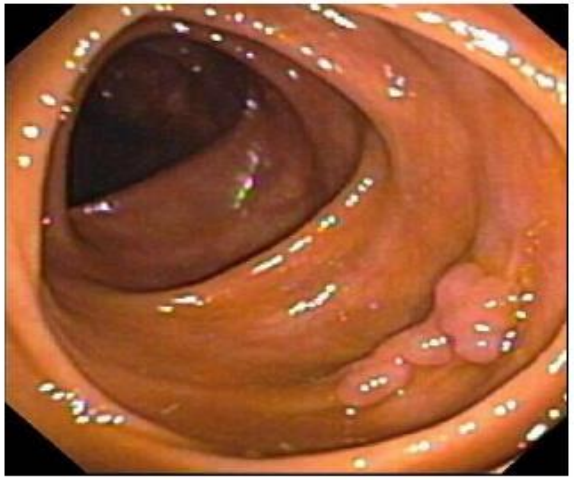


CT Colonography (CTC)

CTC Image



Optical Colonoscopy



Courtesy of Beth McFarland, MD

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Disadvantages-

- No therapeutic benefit.
- Radiation exposure.
- Costly.
- Less available.
- Requires bowel preparation.

Faecal tagging

Positive contrast material-

- Various densities of barium.
- Iodinated contrast agent.
- Combination.

Procedures-

- Low residual diet- 2 days.
- Day before CTC-
  - 3 doses of barium suspension 200ml 4 hrly.
- Distension by air/ co2.

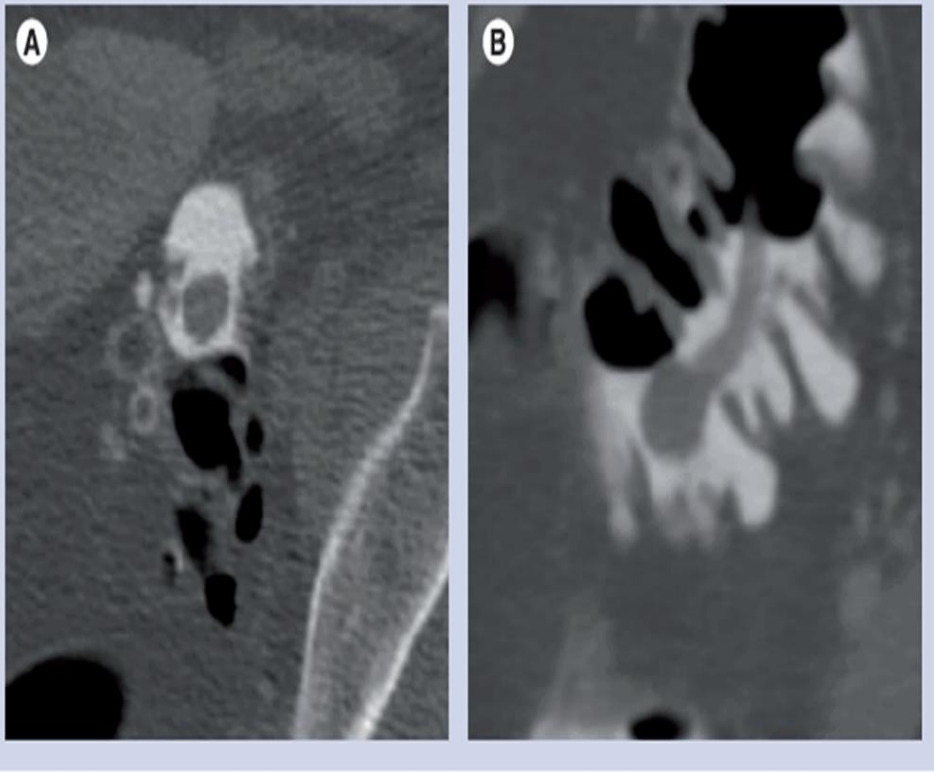


Figure 3. CT colonograph of the colon of a 55-year-old female. Shows a peduncolated polyp in the sigmoid colon. 2D axial CT colonography prone view **(A)** and 2D axial supine view **(B)**. The polyp appears submerged in the tagged iodinated residual fluid.

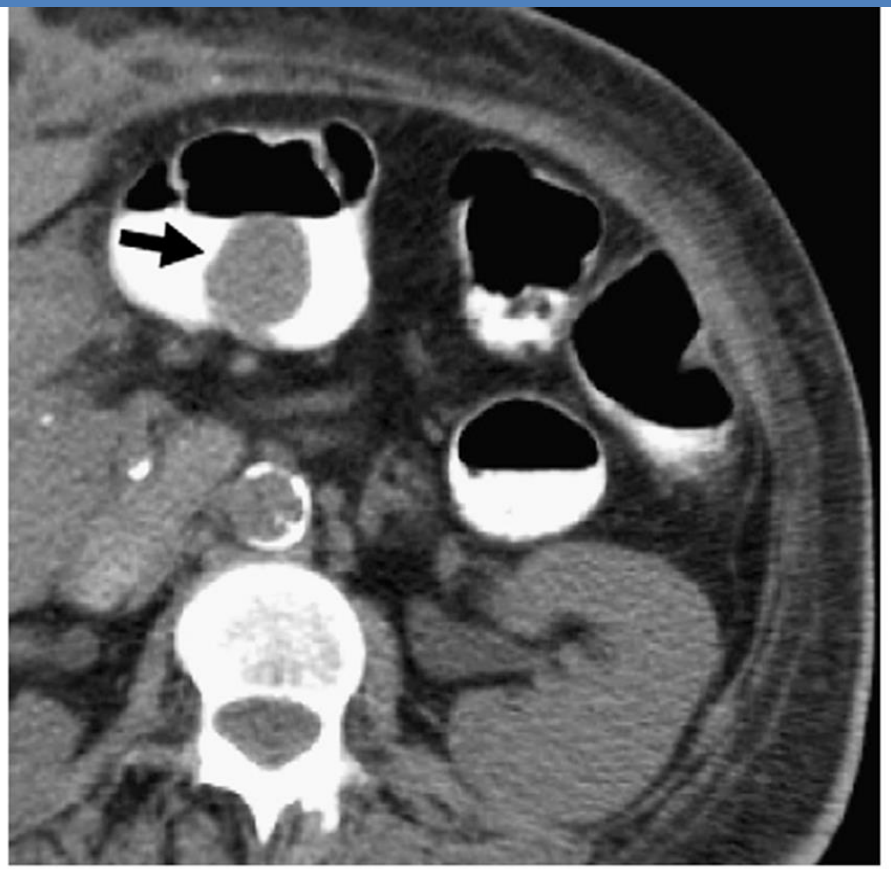
Faecal tagging

Advantages-

- Patient compliance good.
- No bowel preparation.
- Improves differentiation of polyp from residual faeces.

Limitations-

- Efficacy of fluid tagging is less.
- Less than 5 mm / flat adenoma- false –ve – 66%.
- Hypersensitivity.



- Irregular circumferential bowel wall narrowing.
- Apple core appearance.
- Shouldering effect.

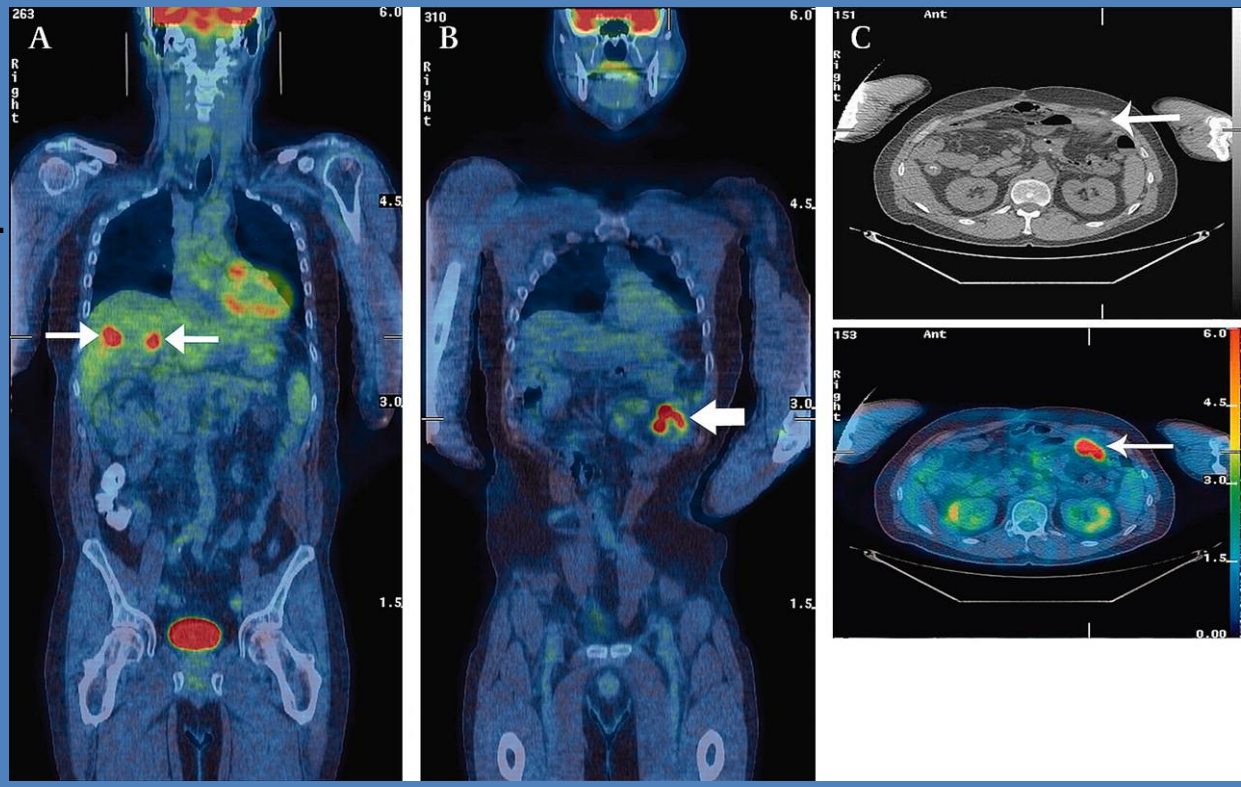
CT Enterography

- MD- CT.
- >1L oral contrast <1 HR & IV contrast.
- 10- 15 min.
- Less radiation.
- Stricture, fistula, abscess.

FDG-PET

Indications-

- Initial diagnosis.
- Detection of recurrence.
- Staging & restaging.
- Response to therapy.



Principle-

Physiologic differences in glucose metabolism by different tissue types.

Disadvantages-

False –ve in cancer with low cellular / metabolic density-

- Mucinous adenocarcinoma.
- Carcinoid tumor.

False +ve –

- Inflammation.

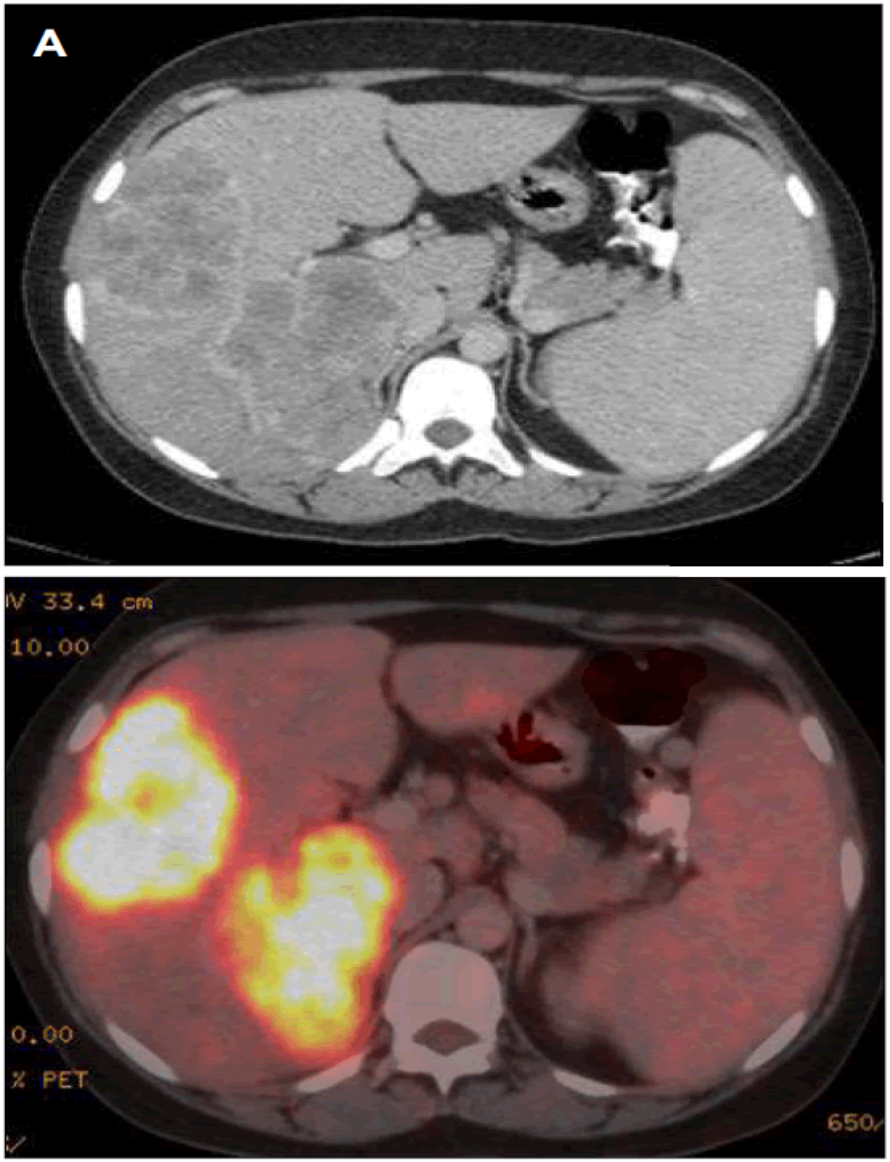


Figure 5 36-year-old female with rectal malignancy. Axial CT (A) shows multiple heterogeneous hypodense lesions in right lobe of liver suggestive of metastasis: M1 stage. Intense FDG uptake (SUV max: 21.5) is seen in axial fused PET/CT image in the liver lesions suggestive of metastasis: M1 stage. These findings were confirmed on surgery and histopathology.


THANK
YOU!