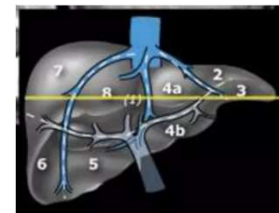


General Medicine Study Day June 2026

Liver Ultrasound : Understanding Segmental Anatomy

Gerry Johnson

Tameside Hospital, Manchester



Objectives

- Quick overview of general anatomy
- Concept of functional anatomy/segments
- Key anatomy to identify segments
- Clinical importance of segments
- Why you should integrate it into your practice

Clinical Relevance of Liver Segmental Anatomy

Oncology and Tumour Localisation

Precise tumour localisation in liver segments guides staging, surgery planning, and targeted therapies like ablation.

Surgical Resection Planning

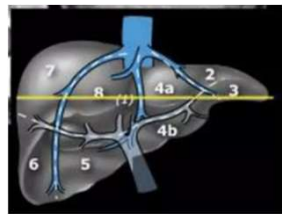
Surgeons use segmental anatomy to perform liver resections while preserving functional liver tissue.

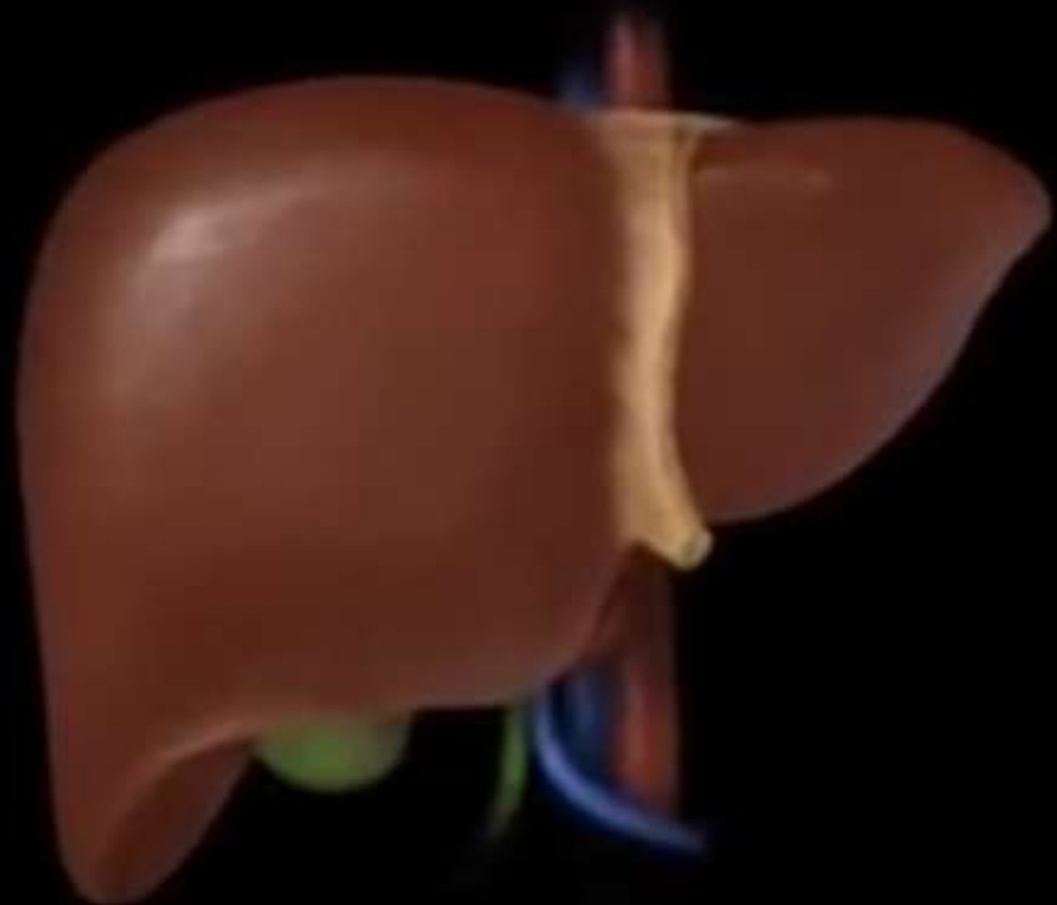
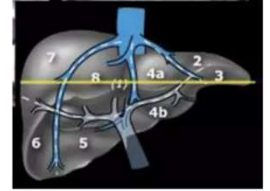
Ultrasound and Diagnostic Imaging

Sonographers apply Couinaud system with vascular landmarks for accurate liver segment identification via ultrasound.

Multidisciplinary Clinical Communication

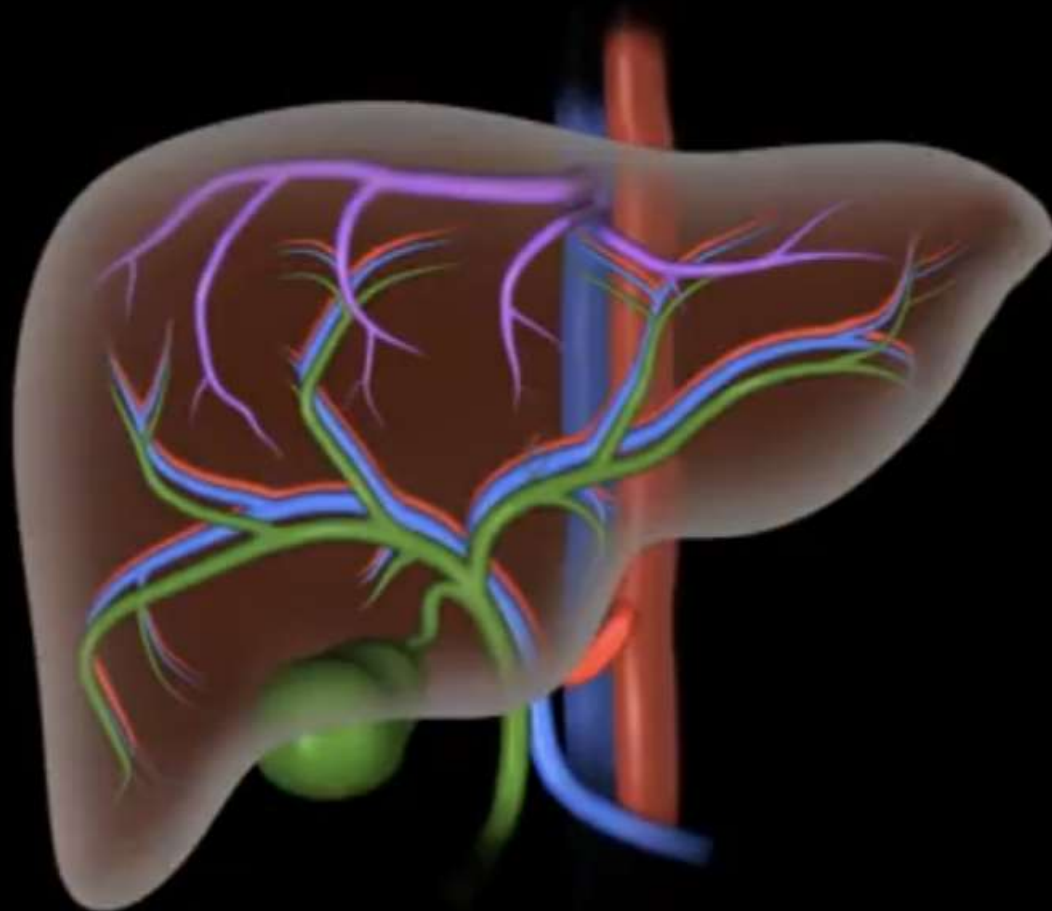
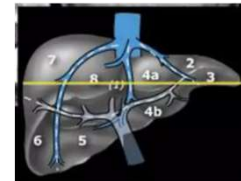
Accurate segmental reporting enhances communication across oncology, surgery, radiology, and sonography teams.





LIVER

Largest solid organ

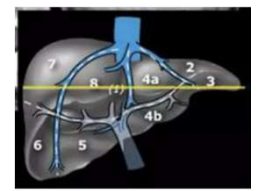


Bile Ducts

Portal Veins

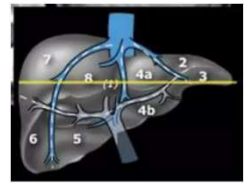
Hepatic
Arteries

Hepatic Veins



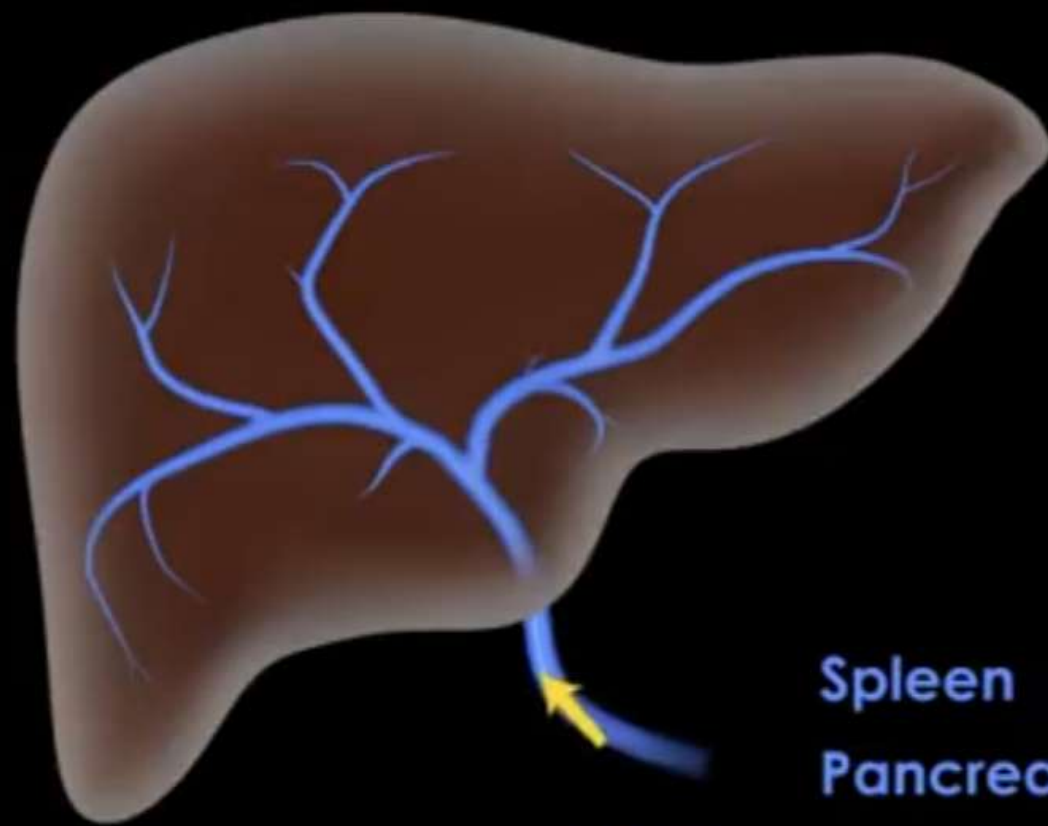
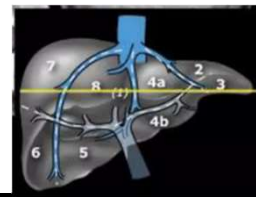
Bile Ducts

Drains bile into
small bowel



Bile Ducts

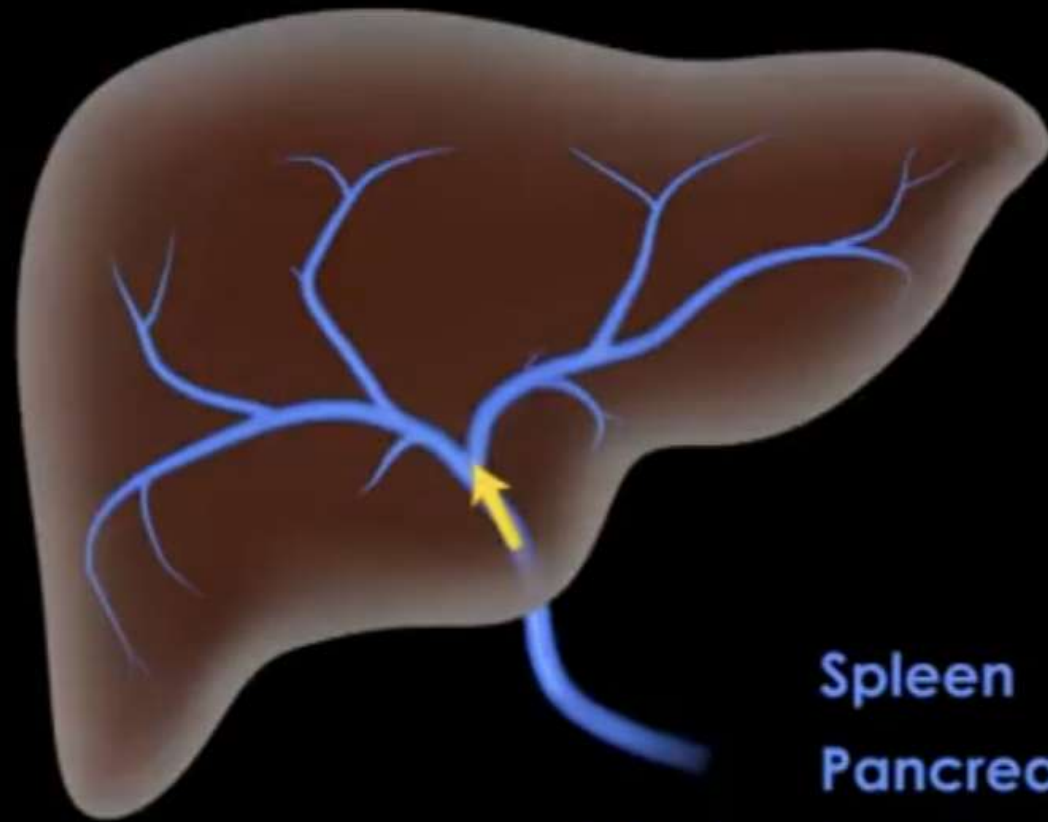
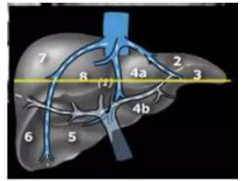
Drains bile into small bowel to allow foods to be digested



Portal Vein

Spleen
Pancreas
Intestines

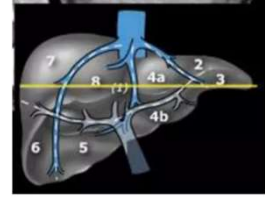
75 %



Portal Vein

75 %

Spleen
Pancreas
Intestines

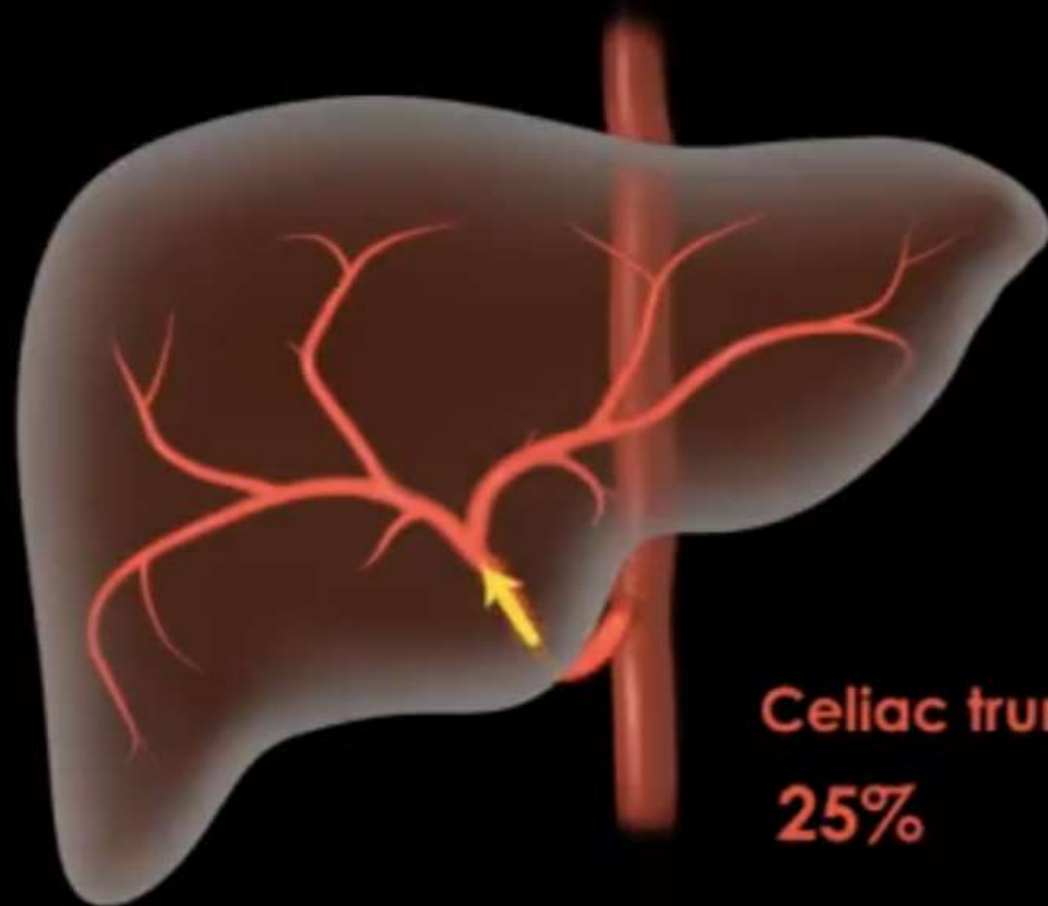
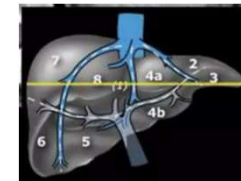


Portal Vein

Nutrient rich
Oxygen poor

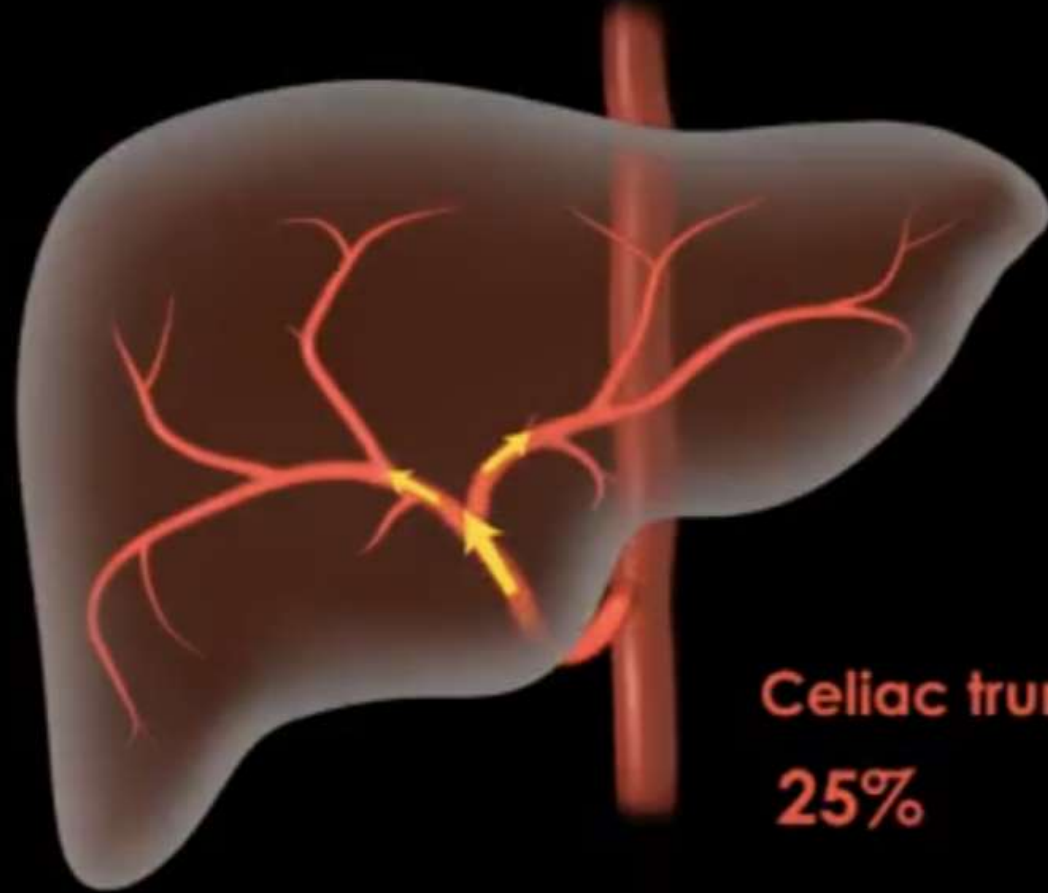
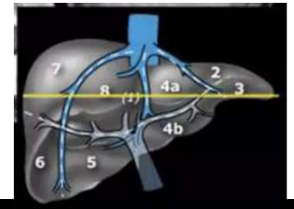
75 %

Spleen
Pancreas
Intestines



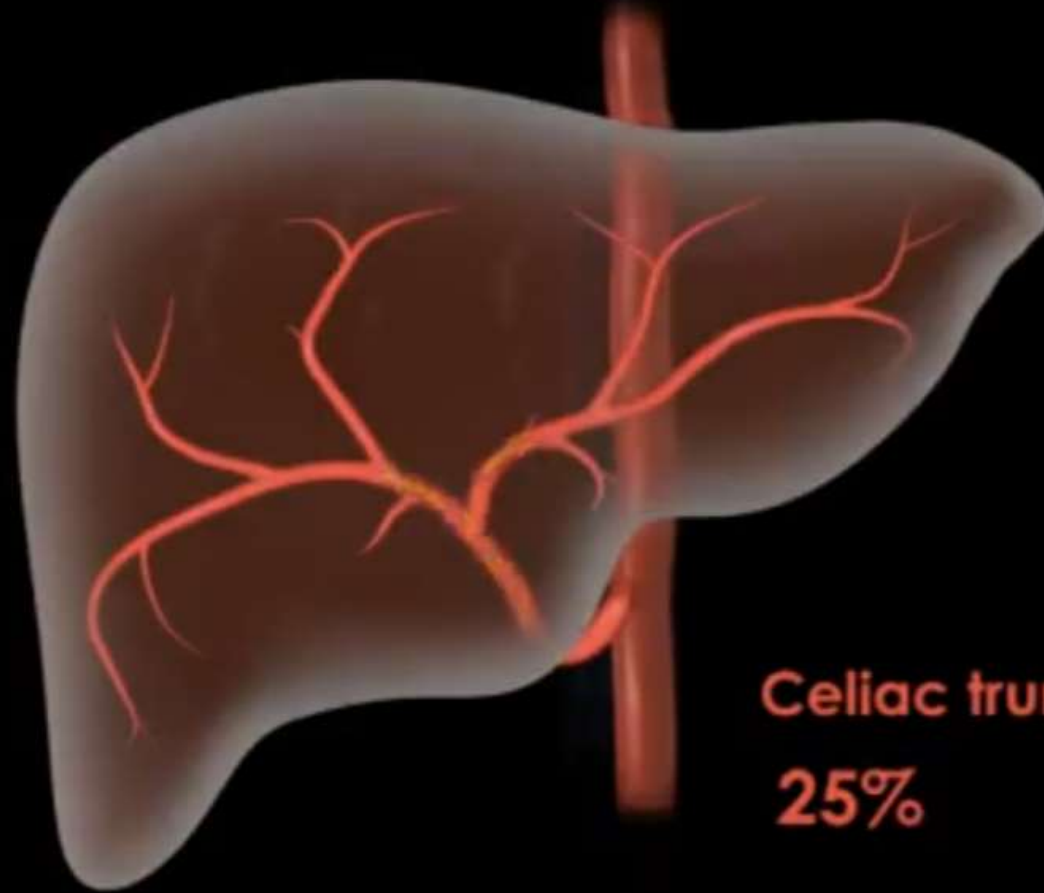
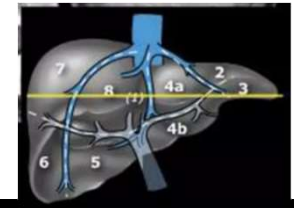
Hepatic Artery

Celiac trunk
25%



Hepatic Artery

Celiac trunk
25%

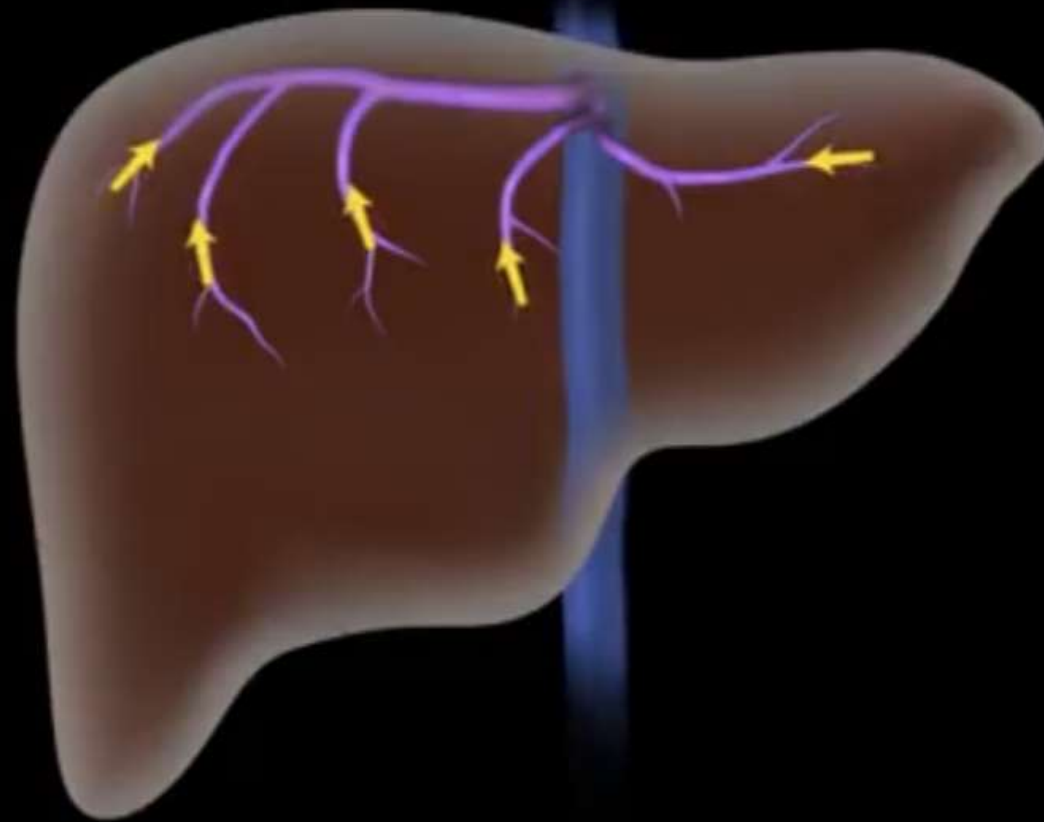
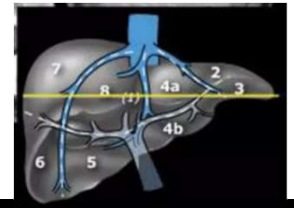


Celiac trunk
25%

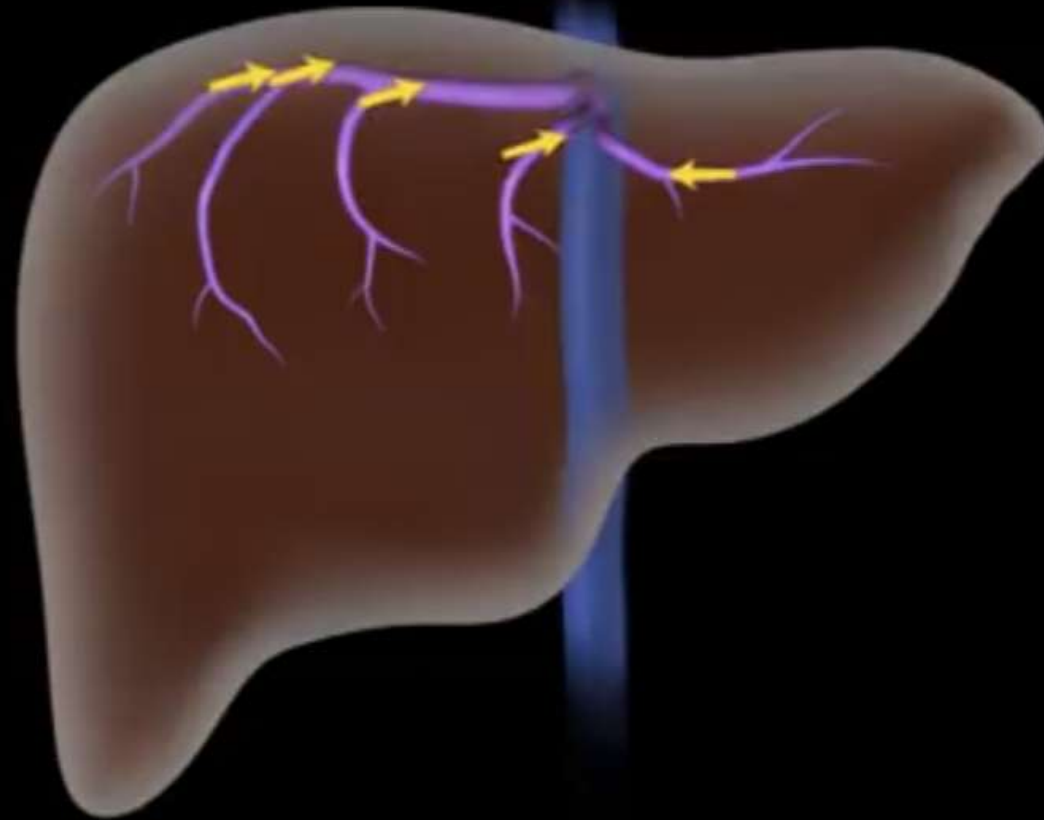
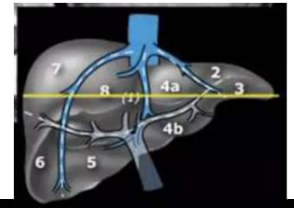
Hepatic Artery

Oxygen rich

Nutrient poor



Hepatic Veins

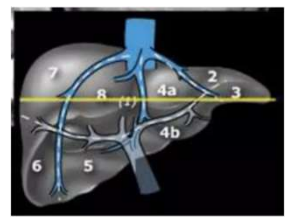


Hepatic Veins

Feed the
nutrients to
the circulation

Liver 'Anatomy'

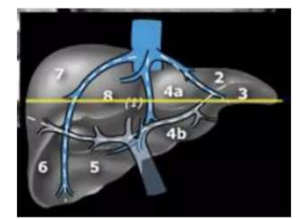
Multiple Descriptors



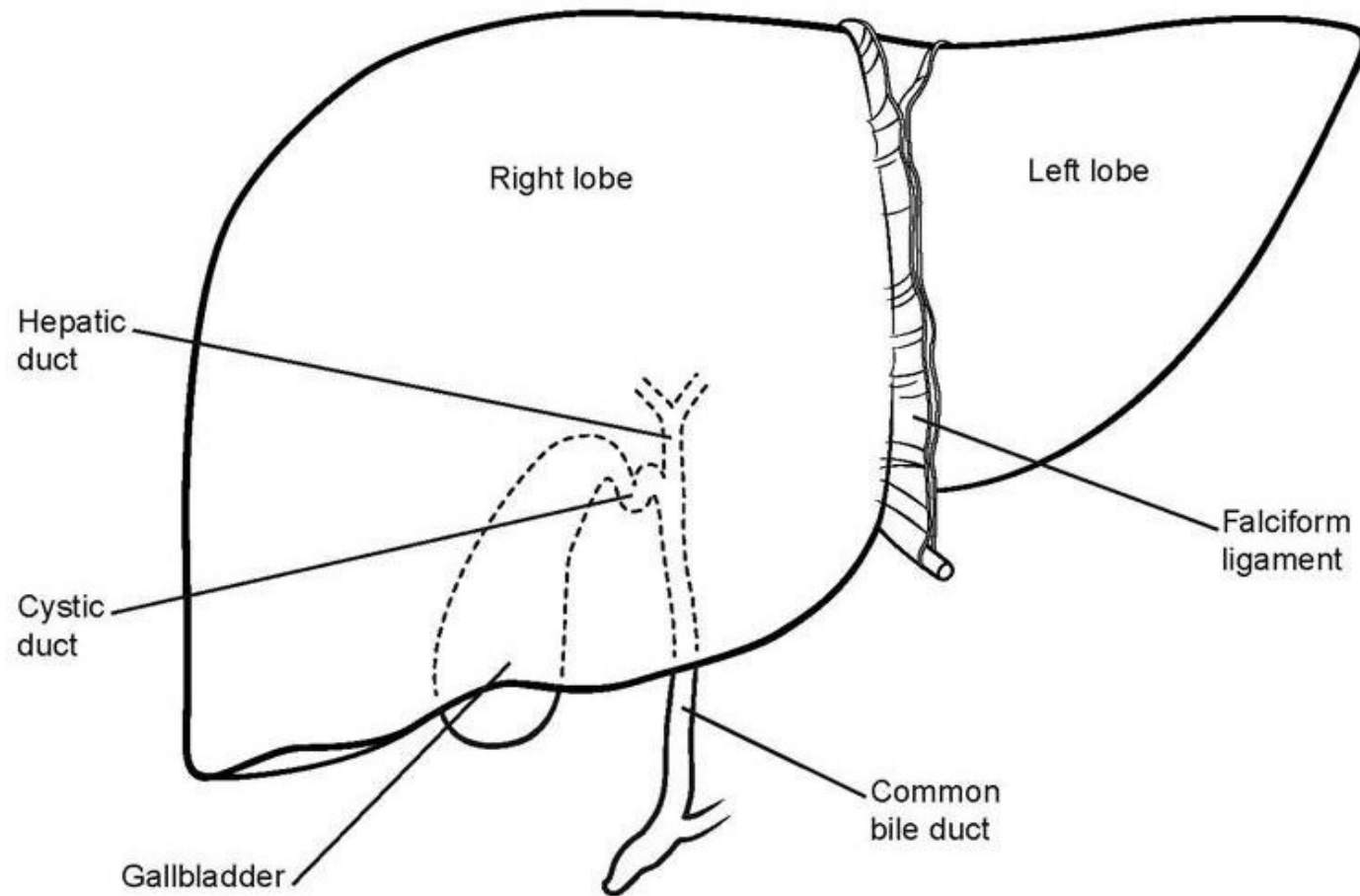
- Right lobe (Visually) Right lobe -
Functionally
- Left lobe (Visually) Left lobe - Functionally

- Right side Right hemi liver
- Left side Left hemi liver

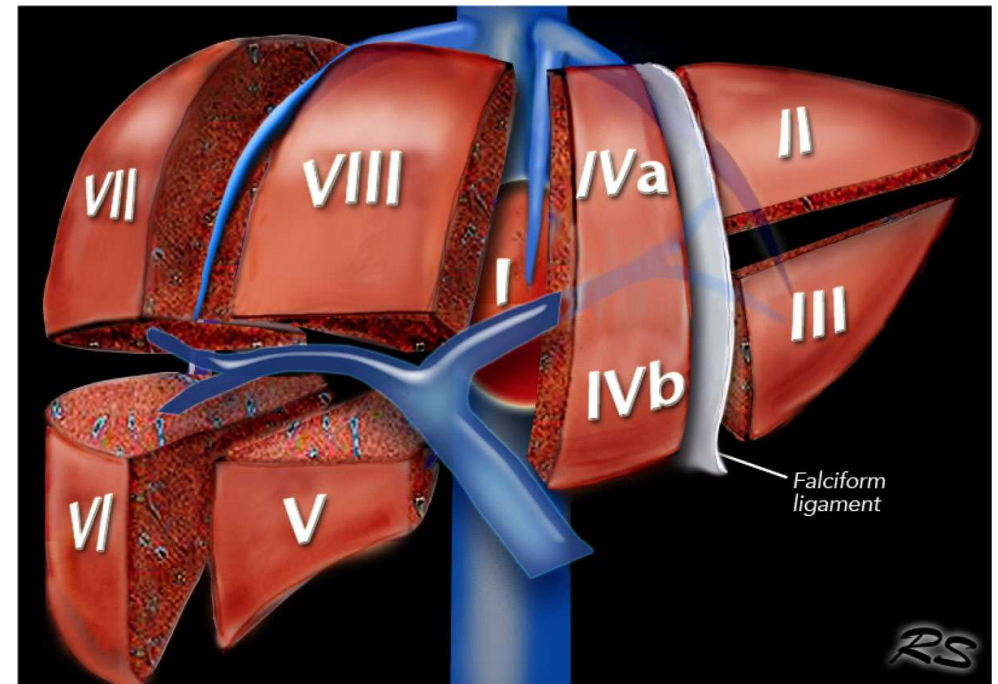
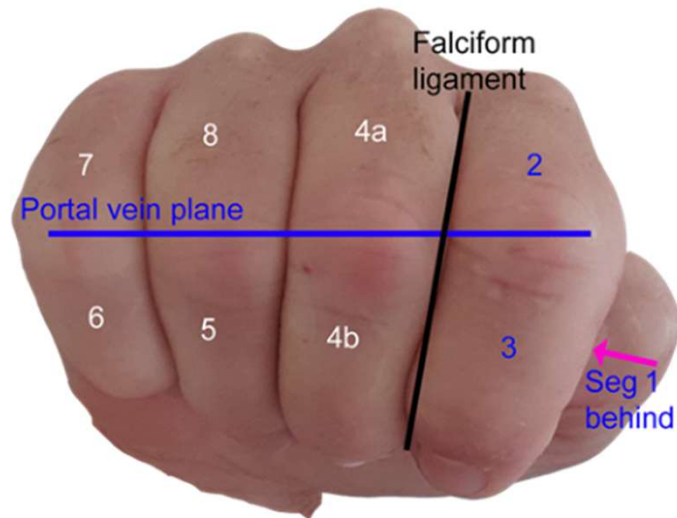
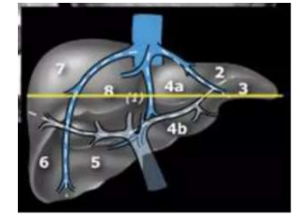
- Right Anterior + Posterior sectors: Inf and Sup
- Left Medial + Lateral sectors: Inf and Sup



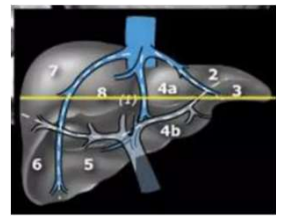
Visual Liver anatomy



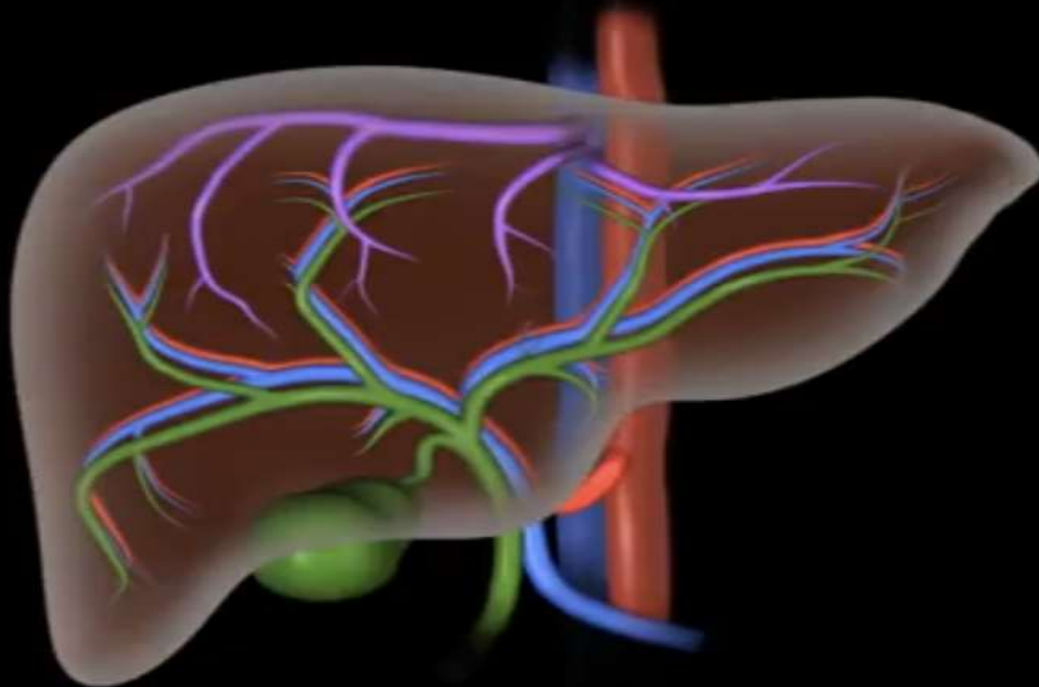
Helpful tool : to understand Segments



Functional Liver Anatomy



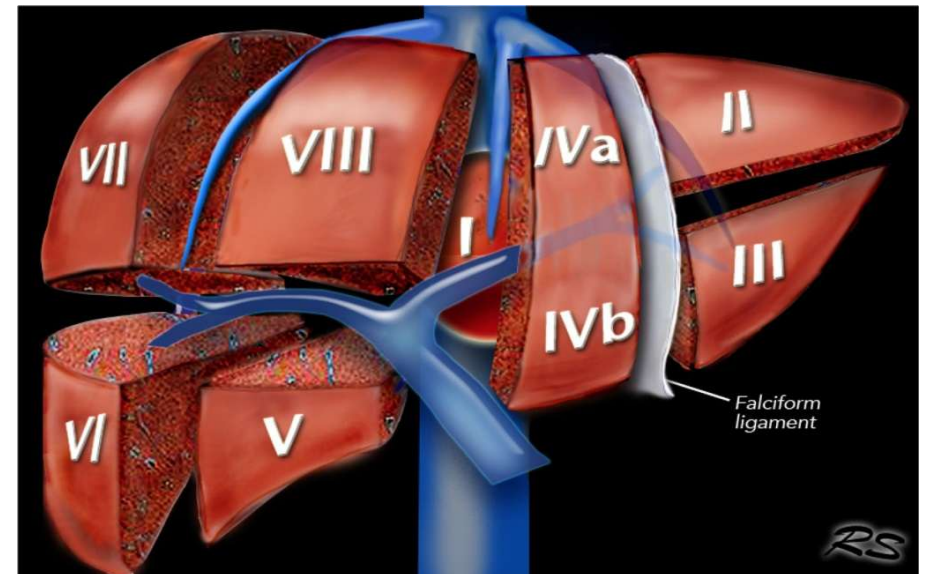
- 8 sub-segments
- Functional anatomical units for surgical resection
- Based on hepatic artery, portal vein, bile duct (Glisson's Triad)



Bile Ducts
Portal Veins
Hepatic Arteries
(Hepatic Veins)

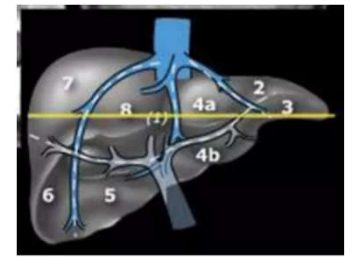
Anatomical Liver Segments

1. Caudate Lobe
2. Left posterolateral
3. Left posteromedial
- 4a. Left superomedial
- 4b. Left inferomedial
5. Right anterolateral
6. Right posteroinferior
7. Right posterosuperior
8. Right anterosuperior



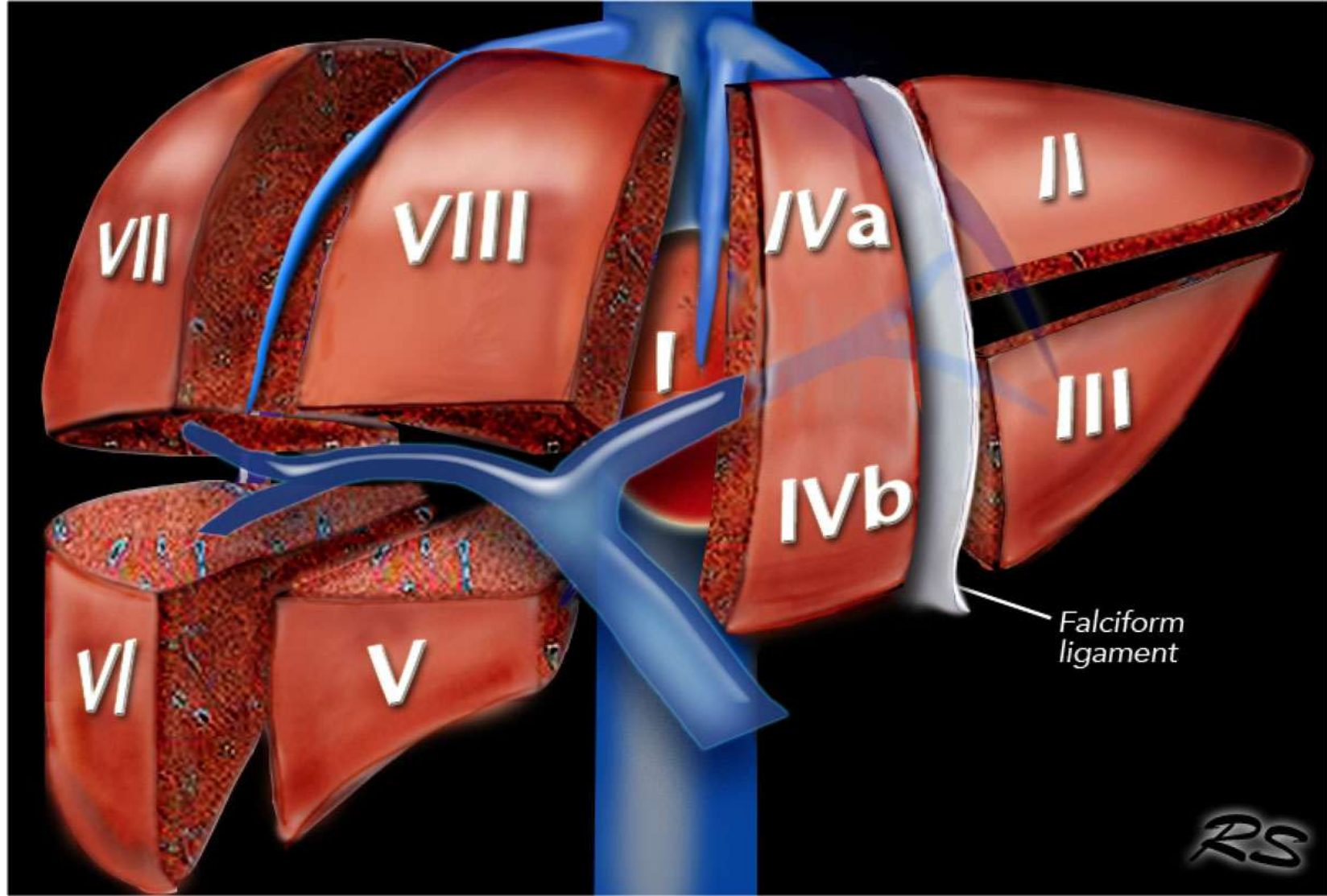
Coinaud (Bismuth subdivided 4 into 4a/b)

Based around venous anatomy



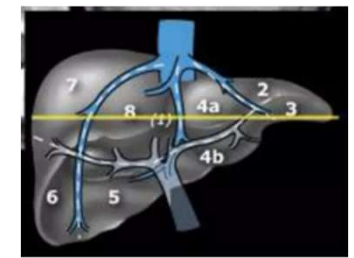
- Significant variation in arterial anatomy
- Significant variation in biliary anatomy
- Venous anatomy more reliable
- Venous anatomy functionally more important

7 ← 8 4 2



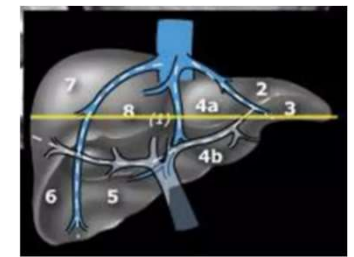
6 ← 5 4 3

Anatomical landmarks based around veins



- Hepatic veins
- Main portal Vein
- Falciform (Ligamentum Teres)
- GB
- Intrahepatic IVC
- Left portal vein (Pars Umbilicalis)
- Ligamentum Venosum (Caudate)

Segment II



Segment -2

Segment II is the superior portion of the left lateral sector of the liver in the Couinaud classification. It lies above the left portal vein, in the left lobe, and is closely related to the diaphragm and anterior abdominal wall in thin individuals.

Anatomical Location

Located in the left lobe

Lateral to the falciform ligament

Superior to the left portal vein

Contacts the diaphragm posteriorly and the stomach anteriorly

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the left hepatic artery (superior branch)
Portal Supply	From the left portal vein (superior branch)
Venous Drainage	Drains via the left hepatic vein into the IVC

Sonographic Appearance

Segment II appears as a wedge-shaped area superior and lateral to the left portal vein.

- Visualized above the portal vein in transverse or coronal scan
- Bordered medially by the falciform ligament
- Often seen near the diaphragm in subcostal views

Clinical Significance

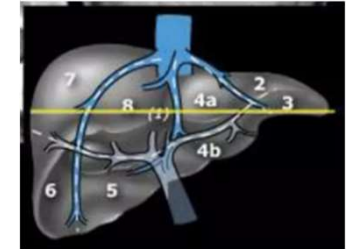
Accessible for percutaneous liver biopsy

Common location for subcapsular lesions such as metastases

Involved in left lateral segmentectomy (Segment II & III resection)

Important in pre-surgical and interventional planning

Segment III



Segment -3

Segment III is the inferior portion of the left lateral sector of the liver in the Couinaud classification. It lies below the left portal vein, in the anterior part of the left lobe, and is in close proximity to the anterior abdominal wall and stomach.

Anatomical Location

Located in the left lobe

Lateral to the falciform ligament

Inferior to the left portal vein

Adjacent to the anterior abdominal wall and stomach

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the left hepatic artery (inferior branch)
Portal Supply	From the left portal vein (inferior branch)
Venous Drainage	Drains via the left hepatic vein into the IVC

Sonographic Appearance

Segment III appears as a triangular or wedge-shaped area below and lateral to the left portal vein.

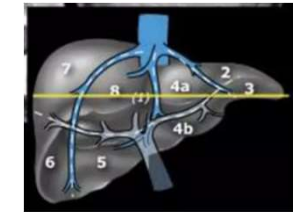
- Visualized inferior to the portal vein in transverse or sagittal views
- Medially bordered by the falciform ligament
- Frequently visible near the anterior abdominal wall

Clinical Significance

Frequently targeted in percutaneous liver biopsy due to superficial location

Commonly involved in left lateral segmentectomy (Segment II & III resection)

Important for surgical resections and tumor localization in preoperative planning



Segment IV (Remember a and b)

Segment -4

Segment IV is the medial segment of the left lobe in the Couinaud classification. It lies between the gallbladder fossa and the falciform ligament and is subdivided into IVa (superior) and IVb (inferior). It is central to liver function and surgical resections.

Anatomical Location

Located in the left lobe

Medial to the falciform ligament

Between the gallbladder fossa and the ligamentum teres

IVa is superior to the left portal vein; IVb is inferior

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the left hepatic artery (medial branch)
Portal Supply	From the left portal vein (medial branch)
Venous Drainage	Primarily via the middle hepatic vein

Sonographic Appearance

Segment IV appears centrally, anterior to the portal vein bifurcation and between the ligamentum teres and gallbladder fossa.

- Visualized in sagittal or oblique subcostal scans
- IVa lies above the portal vein; IVb lies below it
- Located between left and right lobes on imaging

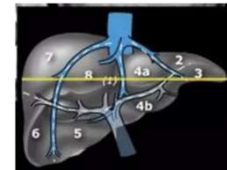
Clinical Significance

Frequently involved in central hepatectomy

Important in identifying liver mass proximity to gallbladder

Includes segments often resected in left trisegmentectomy

Central to bile duct and vascular mapping in liver surgeries



Segment V

Segment -5

Segment V is part of the anterior sector of the right lobe in the Couinaud classification. It lies inferior to the portal vein and anterior to the inferior vena cava and gallbladder fossa. It plays a key role in gallbladder-related interventions and anterior liver surgeries.

Anatomical Location

Located in the right lobe
 Anterior to the right kidney and IVC
 Inferior to the right portal vein
 Adjacent to the gallbladder fossa

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the right hepatic artery (inferior branch)
Portal Supply	From the right portal vein (anterior inferior branch)
Venous Drainage	Primarily via the middle hepatic vein

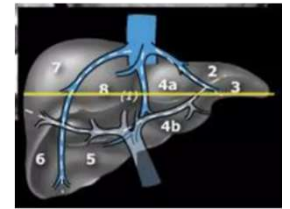
Sonographic Appearance

Segment V appears anterior and inferior in relation to the portal vein bifurcation.

- Visualized in subcostal and sagittal views below the main portal vein
- Located near gallbladder; easily seen during cholecystectomy planning
- Often seen anterior to IVC in transverse scans

Clinical Significance

Common site for gallbladder bed lesions and surgical resection
 Frequently involved in right anterior sectorectomy
 Critical for procedures like transhepatic interventions and gallbladder removal
 Close proximity to biliary tree increases importance in surgical navigation



Segment VI

Segment -6

Segment VI is part of the posterior sector of the right lobe in the Couinaud classification. It lies inferior to the portal vein and posterior to the gallbladder and kidney. It is a key segment for posterior liver surgeries and commonly visualized in intercostal ultrasound views.

Anatomical Location

Located in the right lobe
 Posterior to the gallbladder and anterior to the posterior abdominal wall
 Inferior to the right portal vein
 Adjacent to the right kidney

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the right hepatic artery (posterior inferior branch)
Portal Supply	From the right portal vein (posterior inferior branch)
Venous Drainage	Primarily via the right hepatic vein

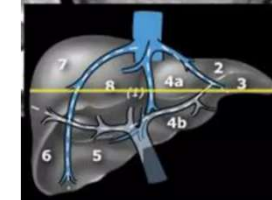
Sonographic Appearance

Segment VI appears posterior and inferior to the main portal vein and right kidney.

- Visualized best using right posterior or intercostal approach
- Posterior to the gallbladder and below segment VII
- Identified near Morrison's pouch in transverse or coronal views

Clinical Significance

Important for right posterior sectorectomy and trauma assessment
 May be involved in posterior hepatic tumors or metastases
 Accessible through posterior and lateral percutaneous approaches
 Adjacent to kidney—relevant for renal-hepatic pathology correlation



Segment VI

Segment -6

Segment VI is part of the posterior sector of the right lobe in the Couinaud classification. It lies inferior to the portal vein and posterior to the gallbladder and kidney. It is a key segment for posterior liver surgeries and commonly visualized in intercostal ultrasound views.

Anatomical Location

Located in the right lobe

Posterior to the gallbladder and anterior to the posterior abdominal wall

Inferior to the right portal vein

Adjacent to the right kidney

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the right hepatic artery (posterior inferior branch)
Portal Supply	From the right portal vein (posterior inferior branch)
Venous Drainage	Primarily via the right hepatic vein

Sonographic Appearance

Segment VI appears posterior and inferior to the main portal vein and right kidney.

- Visualized best using right posterior or intercostal approach
- Posterior to the gallbladder and below segment VII
- Identified near Morrison's pouch in transverse or coronal views

Clinical Significance

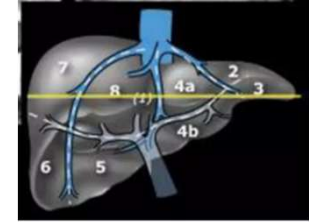
Important for right posterior sectorectomy and trauma assessment

May be involved in posterior hepatic tumors or metastases

Accessible through posterior and lateral percutaneous approaches

Adjacent to kidney—relevant for renal-hepatic pathology correlation

Segment VII



Segment -7

Segment VII is part of the posterior sector of the right lobe in the Couinaud classification. It lies superior to Segment VI and is positioned posteriorly and superiorly, close to the diaphragm. It is one of the most difficult segments to access due to its deep and posterior location.

Anatomical Location

Located in the right lobe
Posterior and superior to Segment VI
Adjacent to the diaphragm
Posterior to the right hepatic vein and right kidney

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the right hepatic artery (posterior superior branch)
Portal Supply	From the right portal vein (posterior superior branch)
Venous Drainage	Primarily via the right hepatic vein

Sonographic Appearance

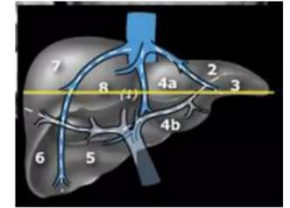
Segment VII appears in the posterior and superior part of the right lobe, beneath the diaphragm.

- Best visualized using intercostal or coronal approach
- Located posterior to right hepatic vein and upper pole of right kidney
- Diaphragmatic motion can assist in localization during scanning

Clinical Significance

Often involved in subdiaphragmatic abscesses or metastases
Challenging location for surgical or percutaneous interventions
Target for interventional radiology in case of deep posterior lesions
Important in planning right posterior sectorectomy

Segment VIII



Segment -8

Segment VIII is the superior portion of the anterior sector of the right lobe in the Couinaud classification. It lies superior to Segment V and is bordered by the middle hepatic vein. It is centrally located and closely related to the hepatic dome, making it essential in central liver procedures.

Anatomical Location

Located in the right lobe
Superior to Segment V
Anterior to the right hepatic vein
Close to the hepatic dome and diaphragm

Vascular Characteristics

Vascular Feature	Details
Arterial Supply	From the right hepatic artery (anterior superior branch)
Portal Supply	From the right portal vein (anterior superior branch)
Venous Drainage	Primarily via the middle and right hepatic veins

Sonographic Appearance

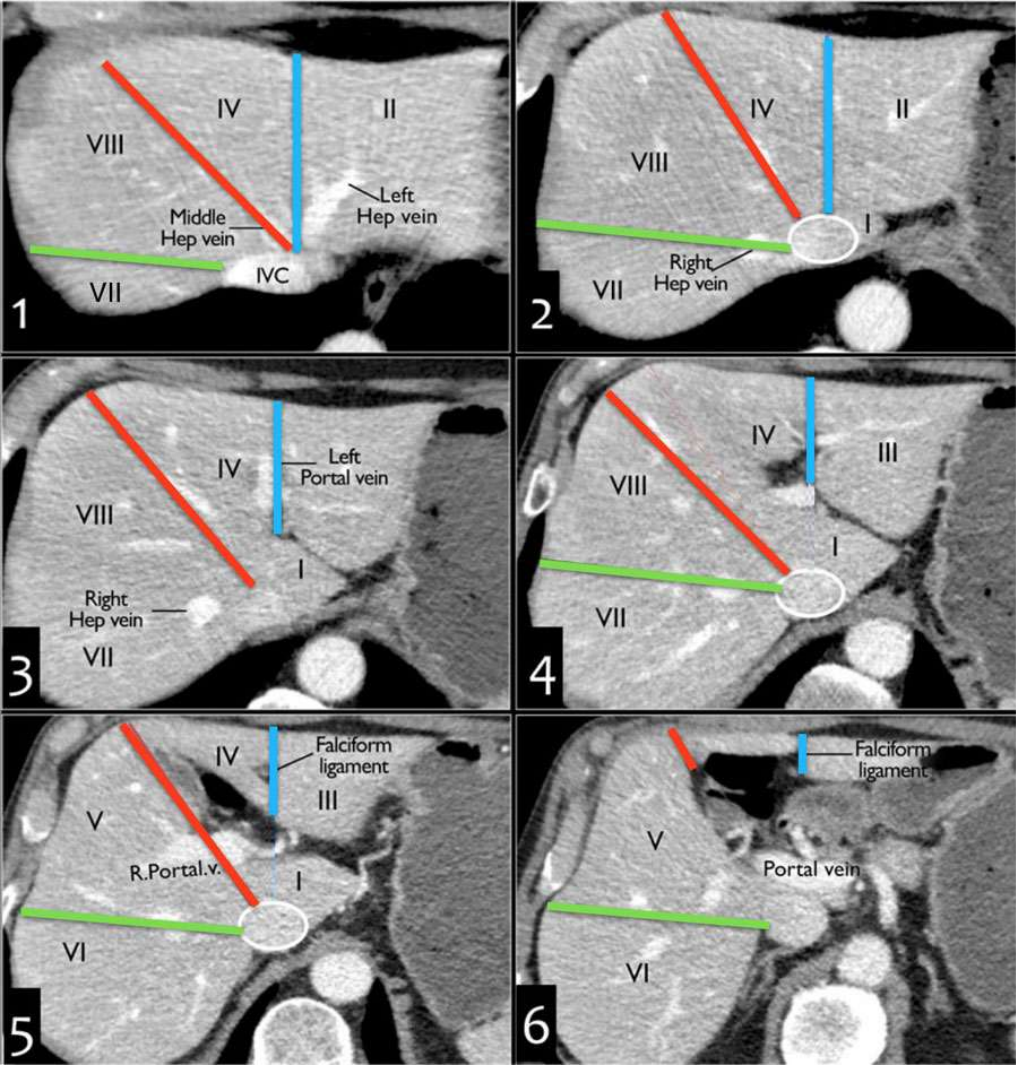
Segment VIII appears in the superior central region of the right lobe, anterior to the right hepatic vein and beneath the diaphragm.

- Visualized best using subcostal or intercostal approach
- Located above segment V and below the diaphragm
- Can be challenging to visualize due to rib shadowing and diaphragm motion

Clinical Significance

Frequently involved in central hepatic resections
Important in evaluation of centrally located hepatic lesions
Diaphragmatic proximity may result in atypical presentation of subcapsular pathologies
Segment VIII resections often require precise preoperative vascular mapping

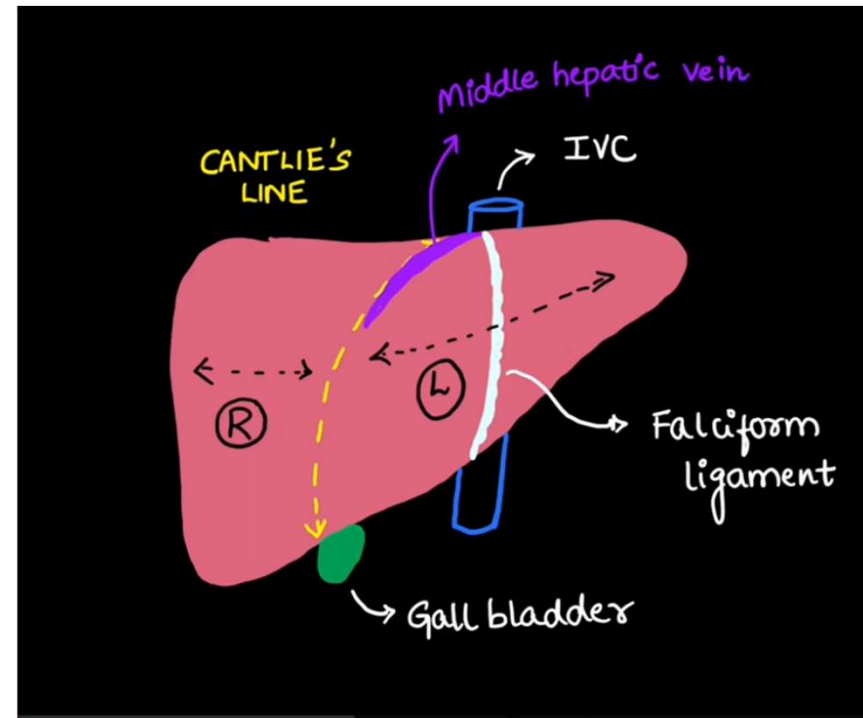
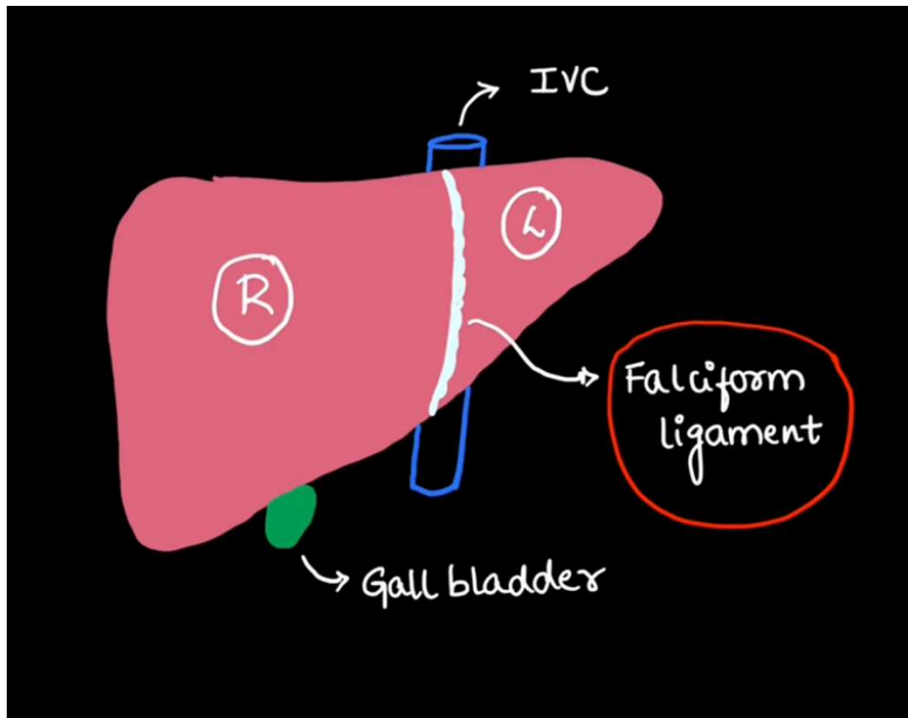
Liver Segments on CT

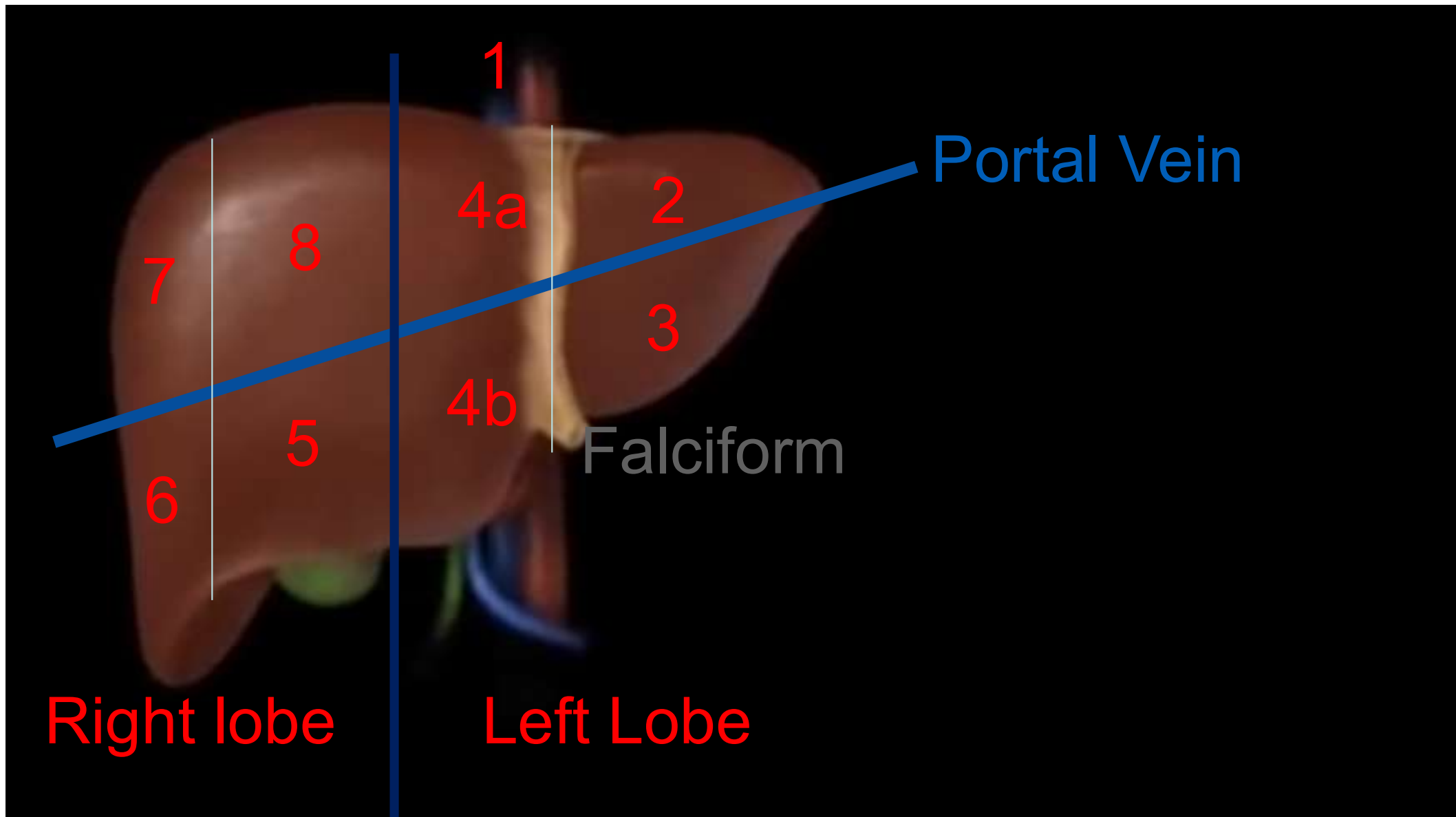


Basic Anatomic dividers

- Upper liver – hepatic veins
- Mid liver – Portal vein/umbilical section of left PV
- Lower liver – falciform and GB fossa

Anatomy can help





Right lobe

Left Lobe

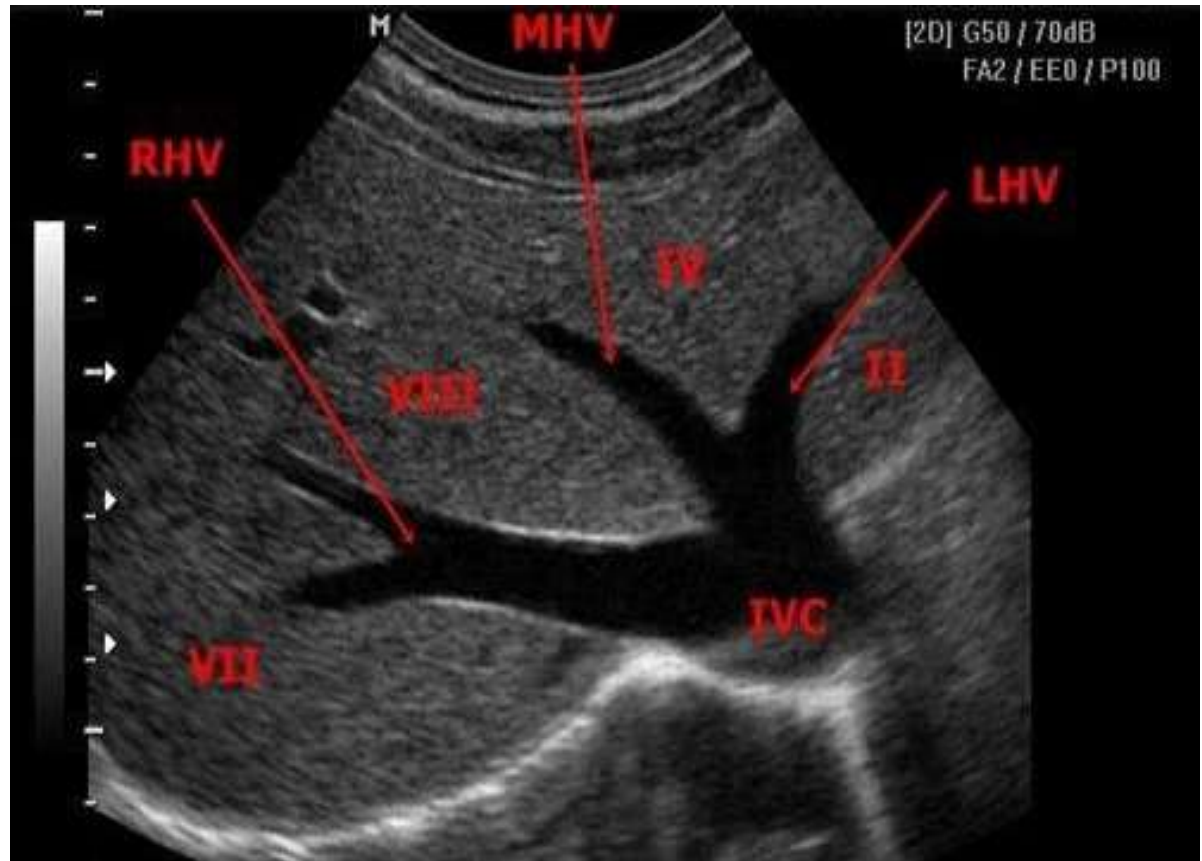
Portal Vein

Falciform

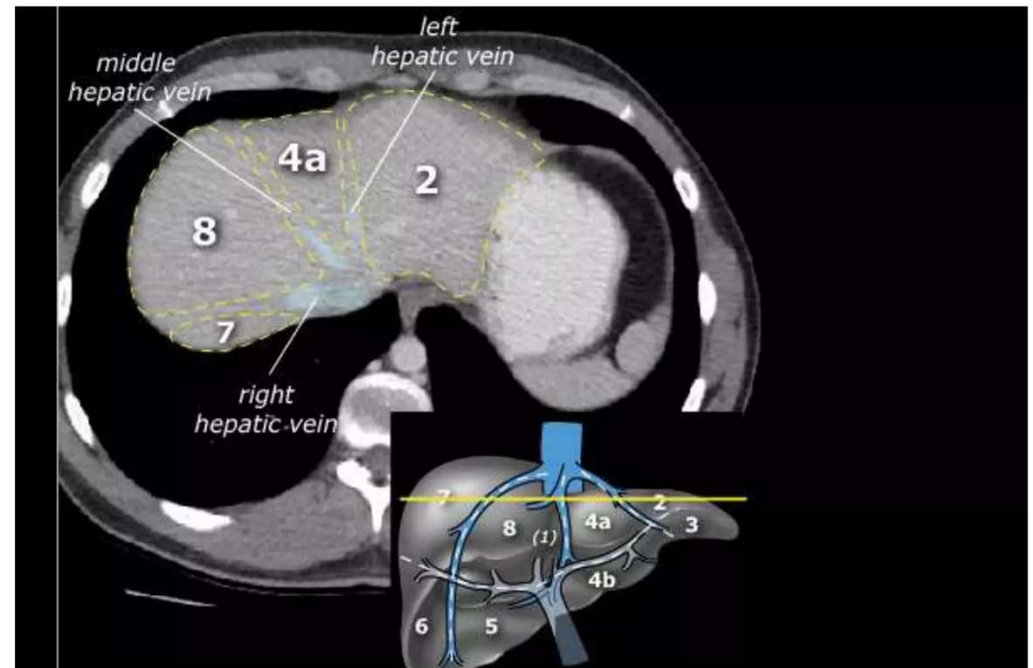
Middle Hepatic Vein

Hepatic veins

- Divide the liver
- Drain the liver
- Intersegmental



Liver Segments CT vs US: Superior above PV



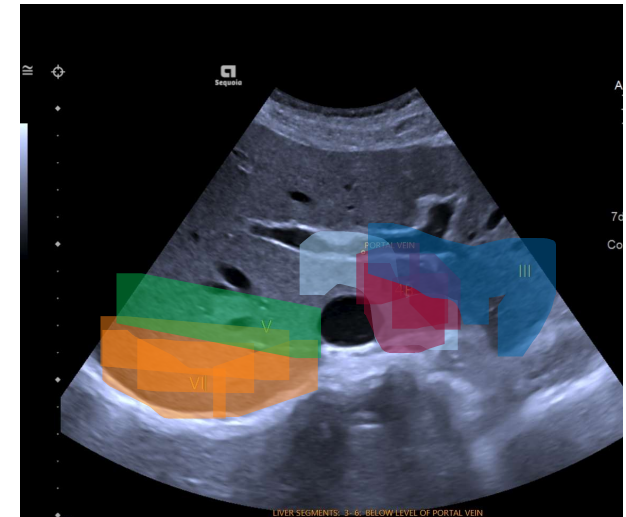
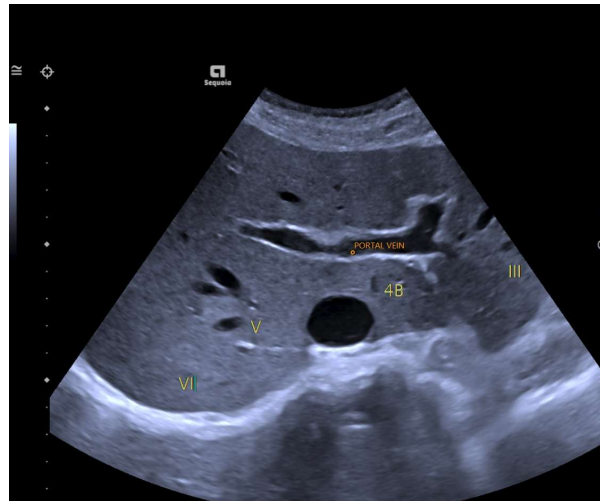
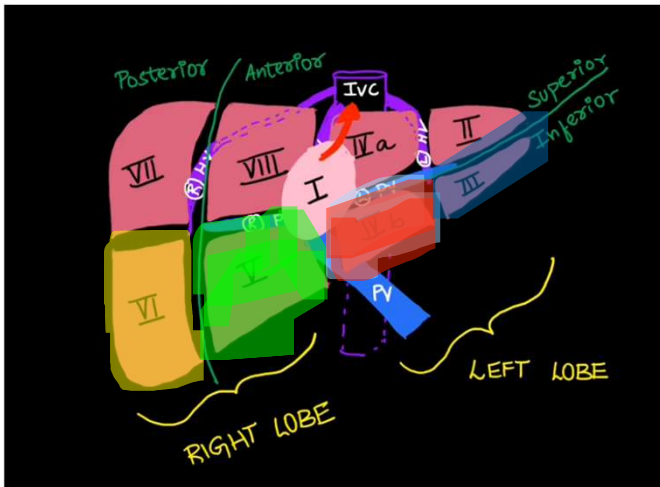
Portal Veins

- Feed the segments
 - Names the segments
 - Defines the functional
- Helps define the lower liver segments(3, 4b, 5, 6)
- Main PV is used to divide SUP from INF Liver

(And to divide anterior and posterior - 5 and 6)



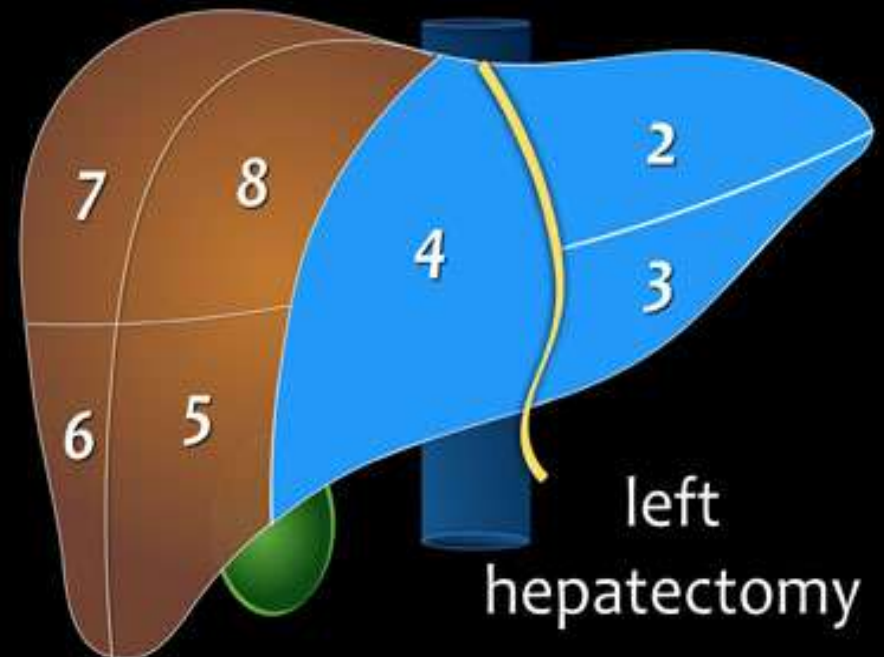
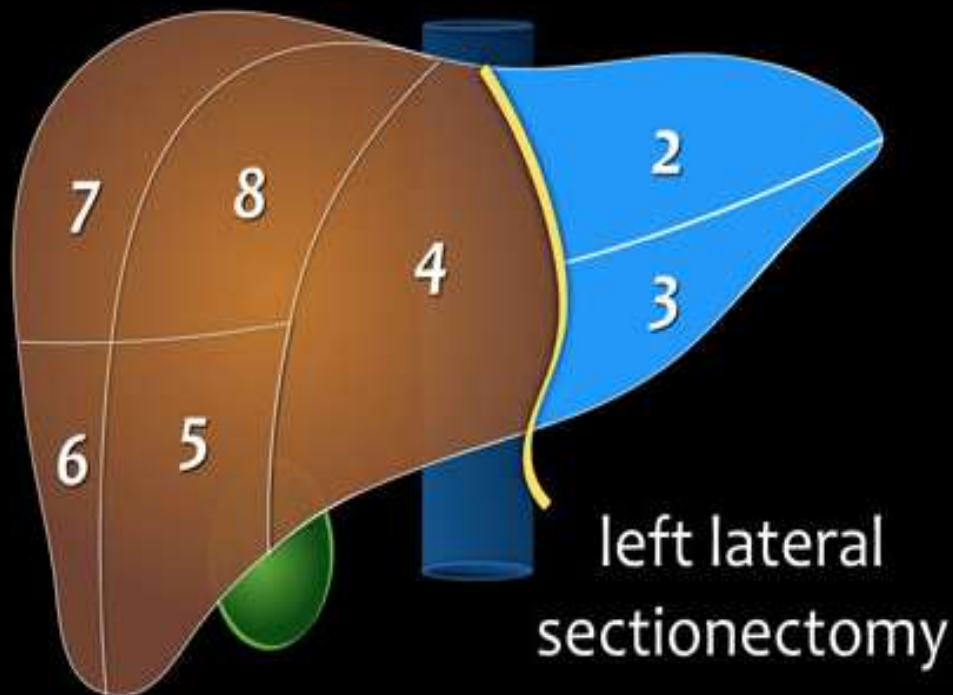
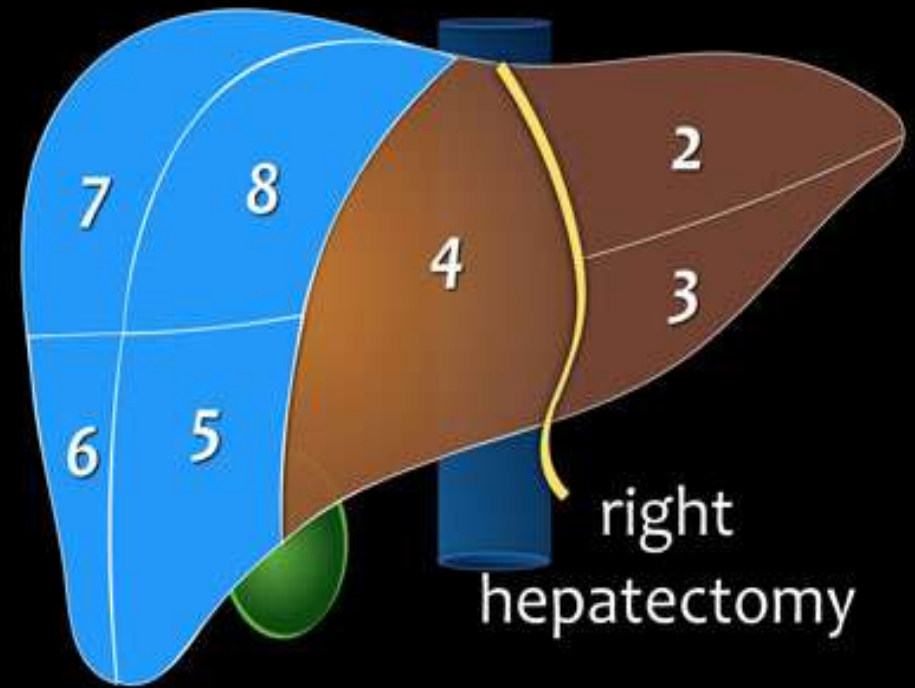
Liver Segments : below PV, 3, 4(b), 5, 6



Why is it important?

Surgery

- Right
- Left

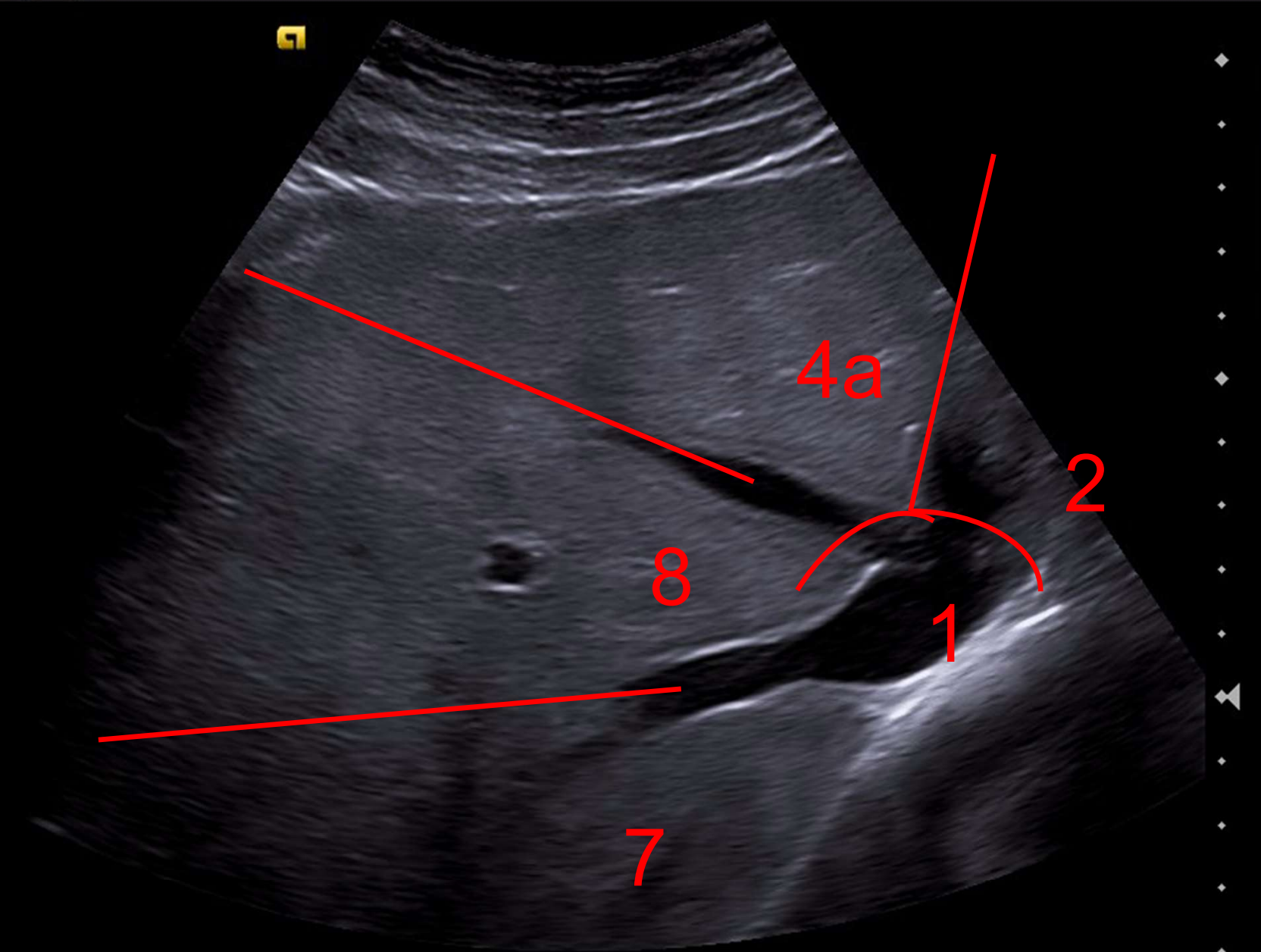


Summary

- Segmental anatomy vital for surgery
- Important for standardisation
- Opportunity to prevent/avoid CT errors
- Important for Biliary intervention

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CH5-2
KIDNEYS
0 dB
THI 3.6 MHz
DR 55 dB
Edge 3
Persist 3
R/S 3
Map D
Tint 2
DTCE Med
18 fps



x 03_12_2018_18_24_46

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0 dB
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