



# ULTRASOUND IN LIVER TRANSPLANT

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# ACKNOWLEDGEMENTS

- Dr Dominic Yu
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# USES & BENEFITS

- Liver transplant – irreversible acute and chronic liver diseases
- Detection of complications
- Follow up of early and late complications
  - Vascular (PV/HA/IVC stenosis/thrombosis, pseudoaneurysms, ischaemia)
  - Biliary (leak, strictures, cholangitis)
  - Extrahepatic (collections – haematoma, abscess, seroma)
  - Malignancy
- Safe - no ionising radiation
- Dynamic, can be performed at bedside post-op

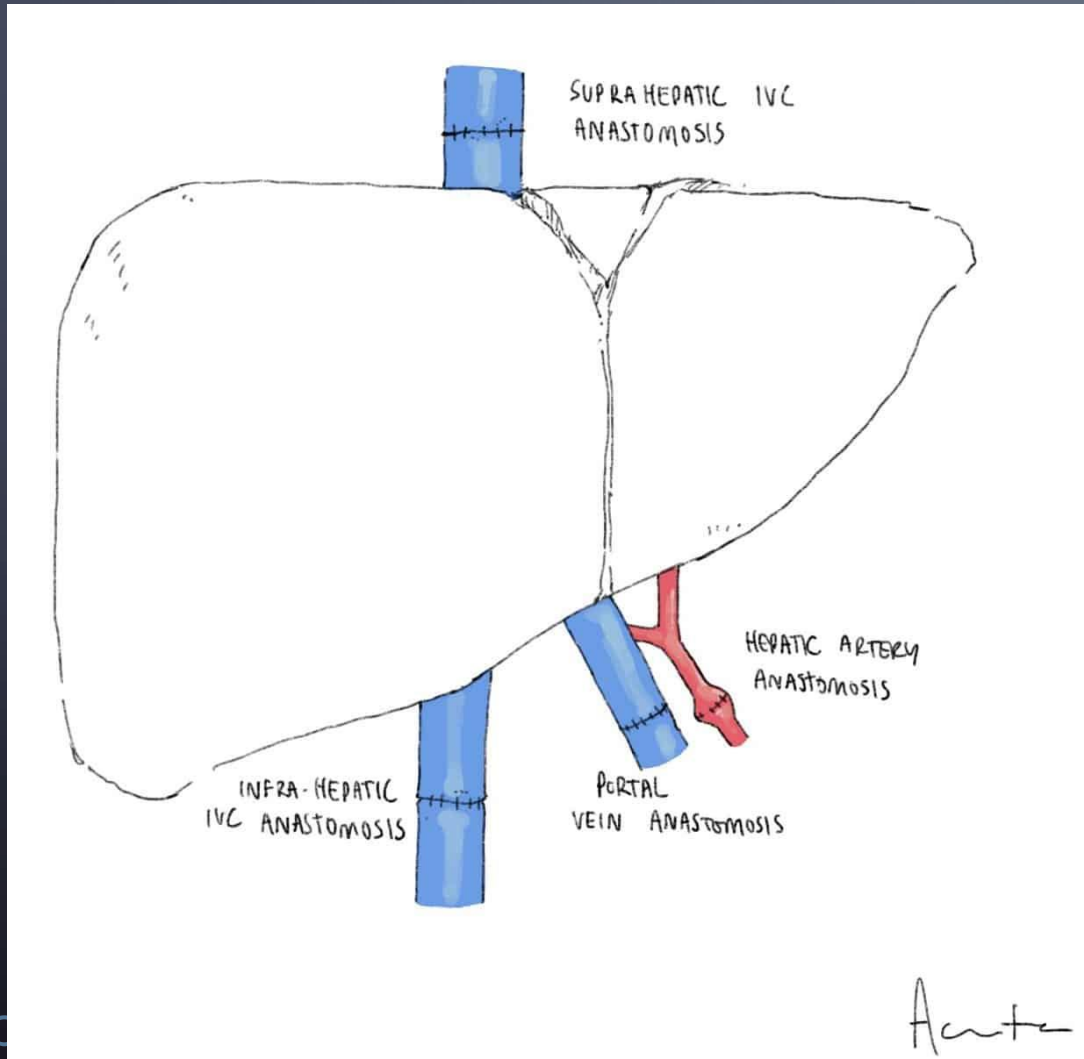
# TYPES OF LIVER TRANSPLANT

- Orthotopic liver transplant (OLT) – most common, recently deceased donor
- Split graft – smaller left lobe (child), larger right lobe (adult)
- Living donor
- Auxiliary – part of/native liver retained

# LIVER TRANSPLANT SURGICAL ANATOMY

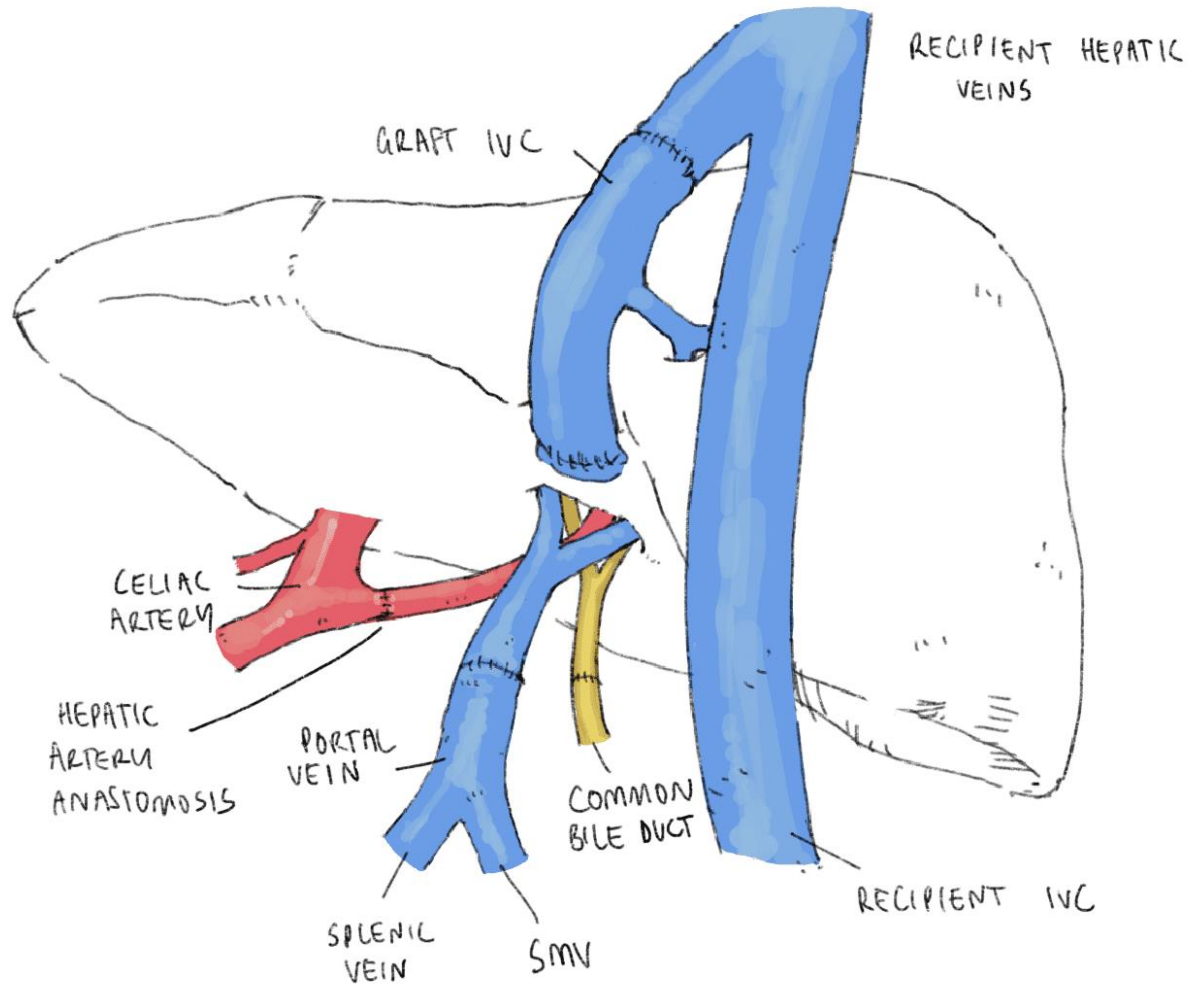
- Arterial anastomosis
- Portal venous anastomosis
- IVC anastomosis
- Biliary anastomosis

# CLASSIC APPROACH OLT



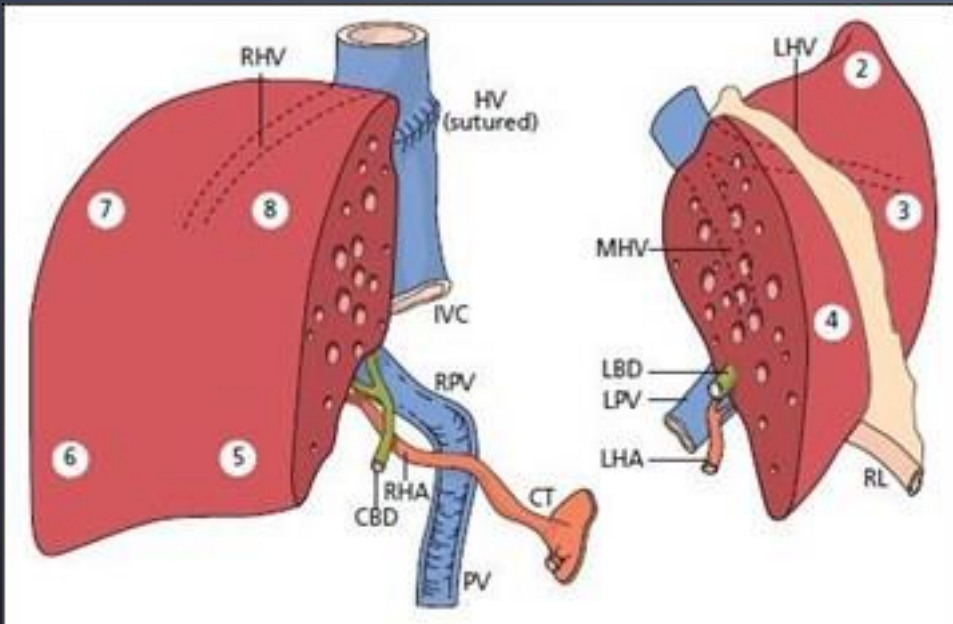
- Retrohepatic IVC removed *en bloc*
- Interruption of venous return when clamping iVC → resultant haemodynamic compromise to vital organs

# PIGGYBACK TECHNIQUE

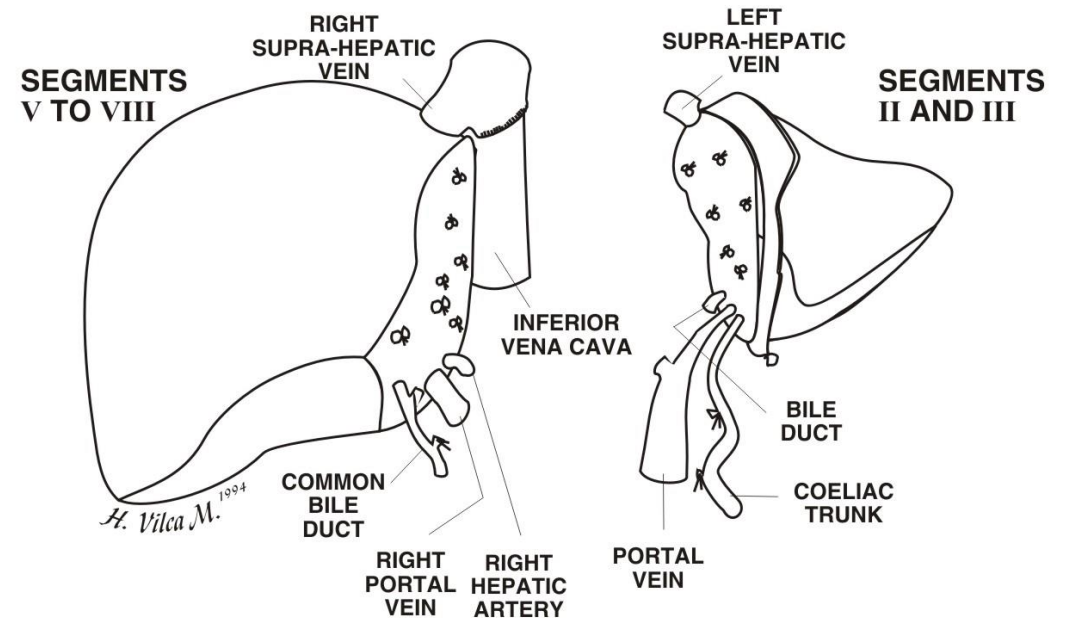


- Donor IVC attached to recipient IVC end-to-side or side-to-side. Venous cuff from recipient hepatic veins
- PV and HA – end-to-end
- Biliary – duct to duct or Roux-en-Y hepaticojejunostomy

# SPLIT LIVER TRANSPLANTATION

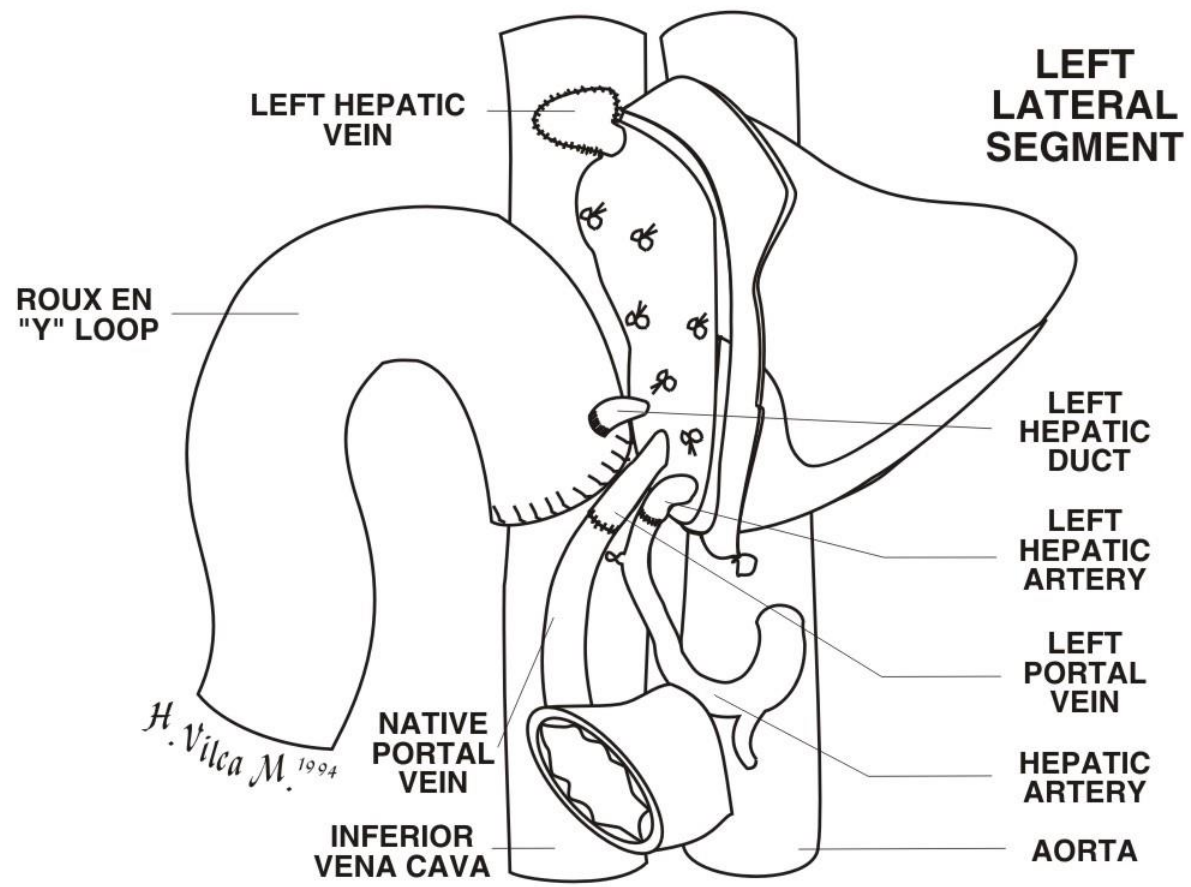


## SPLIT - LIVER GRAFTS

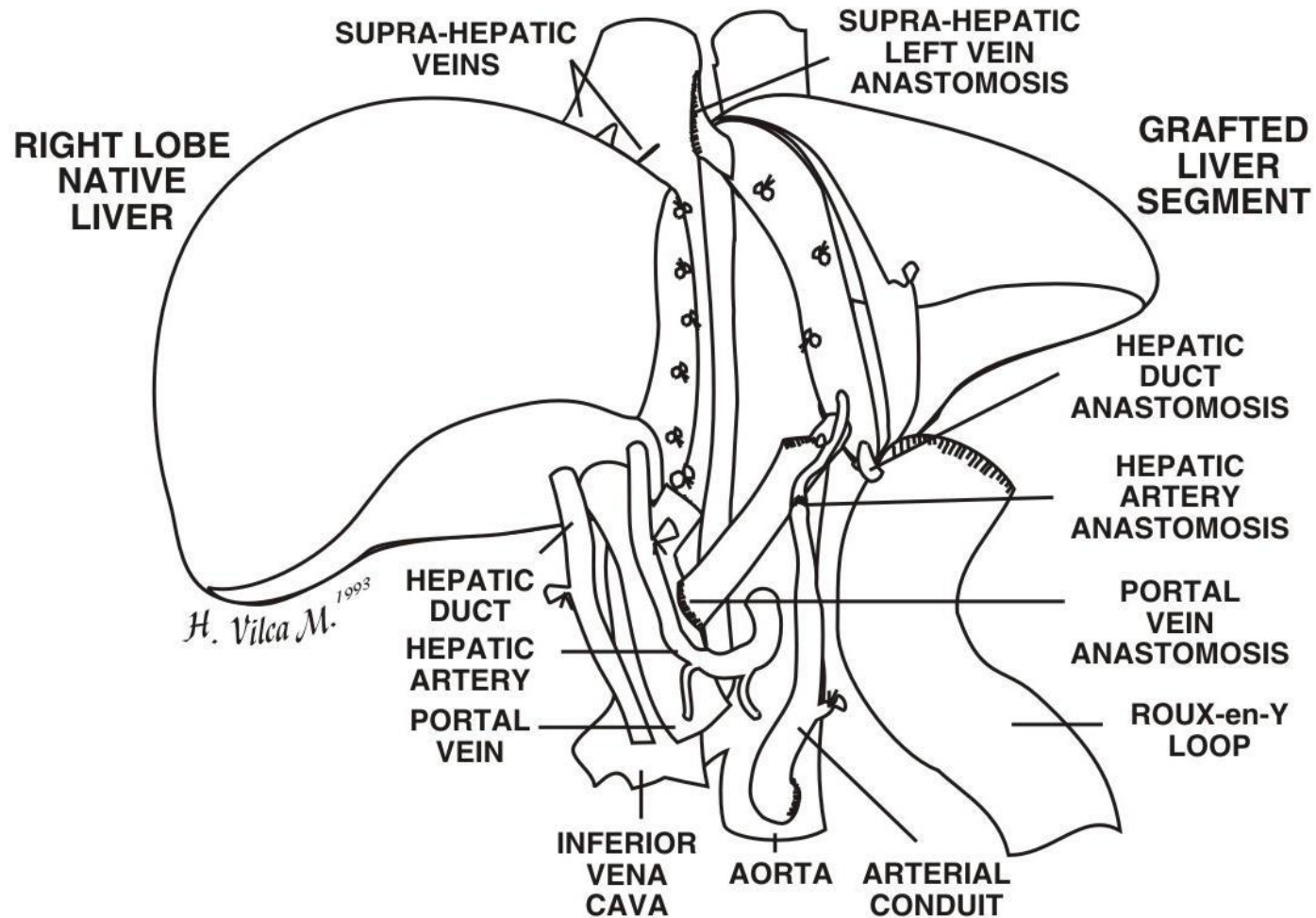




# LEFT LATERAL SEGMENT LIVER TRANSPLANTATION

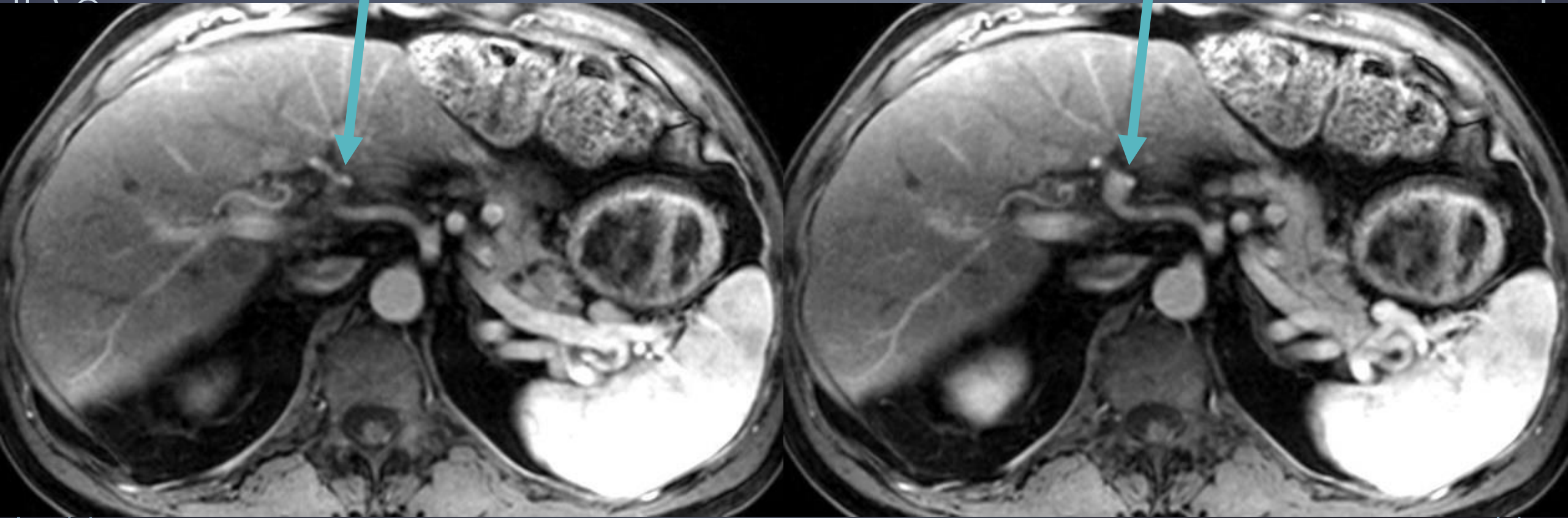


# LEFT AUXILIARY ORTHOTOPIC LIVER TRANSPLANTATION



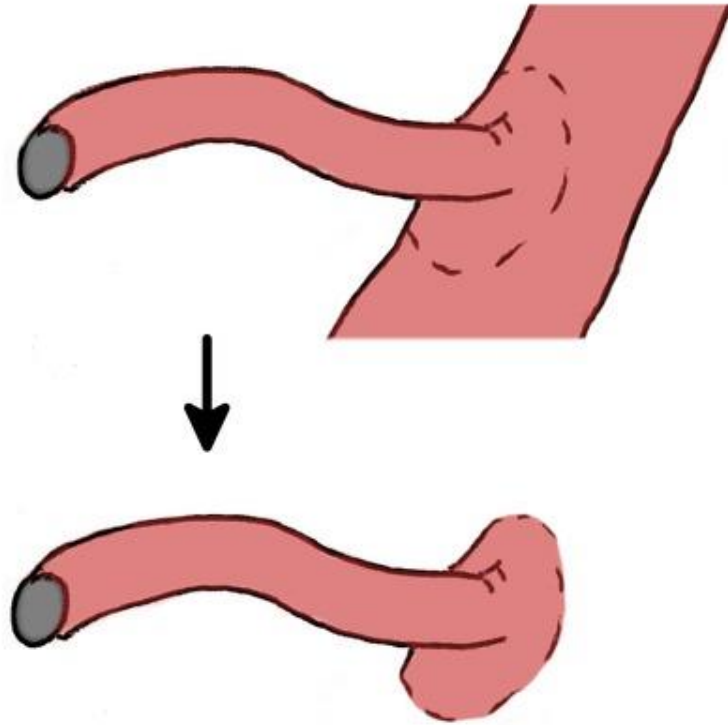
# ARTERIAL ANASTOMOSIS

- End-to-end - Donor's coeliac axis and recipient's common hepatic artery
- End-to-side, back table reconstructions if anatomical variant
- Conduit – recipient aorta (aortohepatic conduit), viscerohepatic (e.g. splenohepatic conduit)



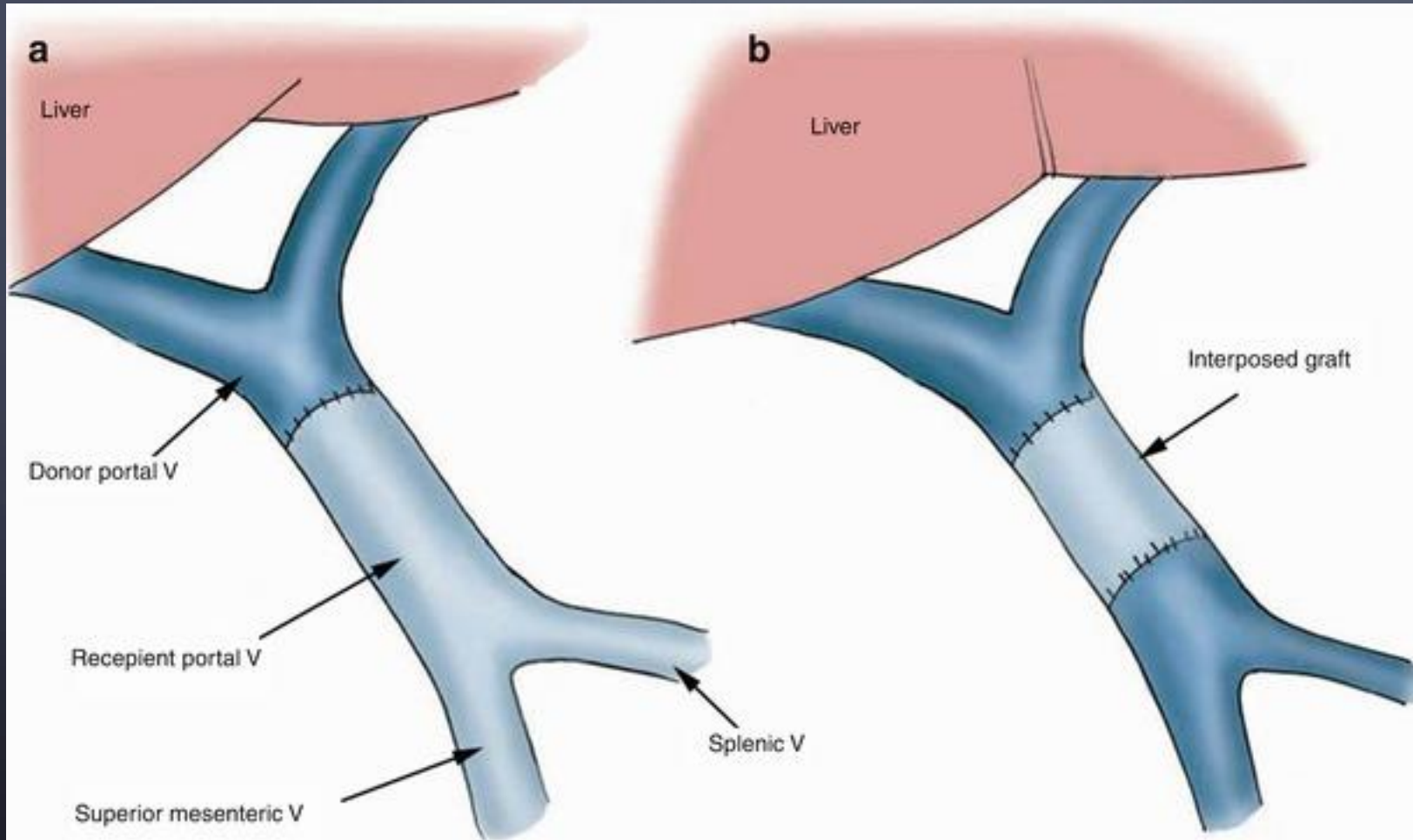
- Donor coeliac trunk patch anastomosed to recipient CHA/GDA branch point (end-to-side)
- Case courtesy of Brian Gilcrease-Garcia, Radiopaedia.org, rID: 54640

## Carrel Patch

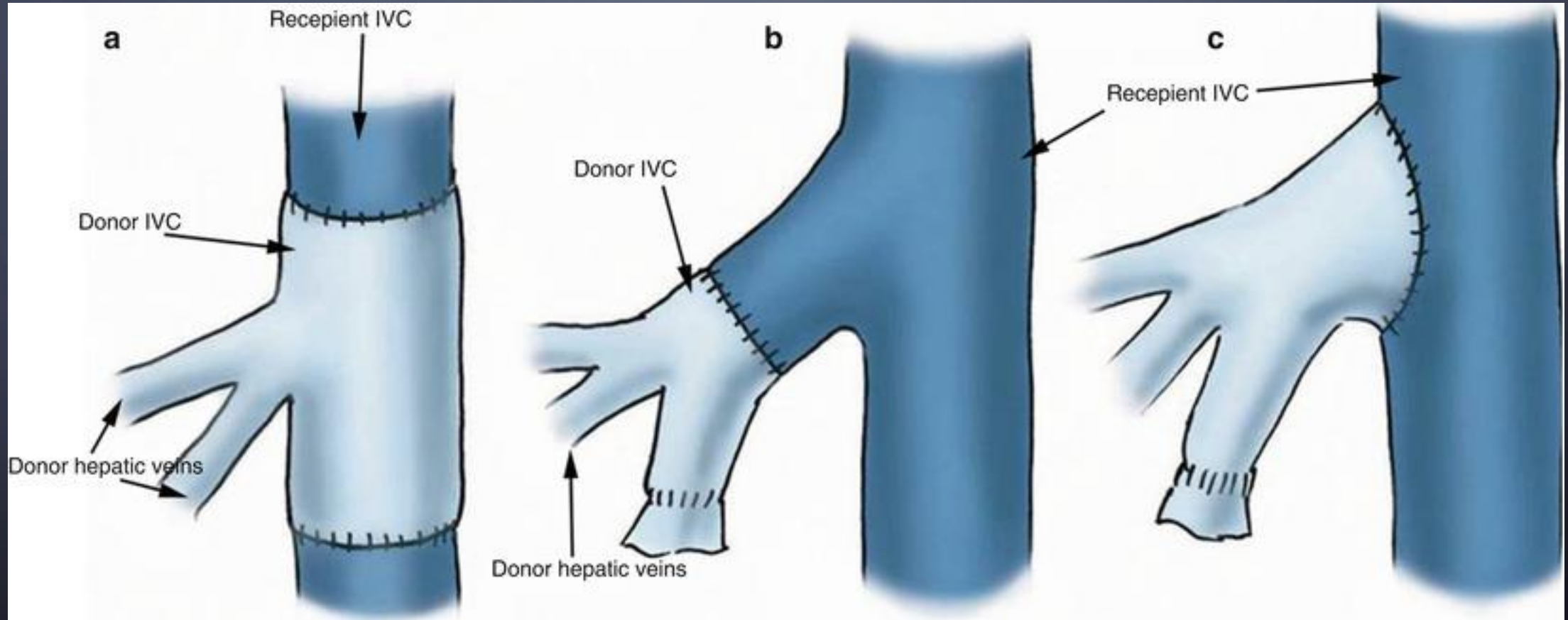




# PORTAL VEIN ANASTOMOSIS



# IVC ANASTOMOSIS



a) Intercaval connection

b) "Piggyback" connection

c) Cavoplasty patch onto recipient IVC

# THE TRANSPLANT LIVER

- Derives majority of supply from hepatic artery (unlike native liver – PV)
- Early arterial occlusion – graft may not survive
- Arterial complications: thrombosis, anastomotic stenosis, pseudoaneurysm
- Portal venous: thrombosis, anastomotic stenosis, portal hypertension
- Bile duct only supplied by HA
- Biliary complications (20/100)



# NORMAL TRANSPLANT LIVER US

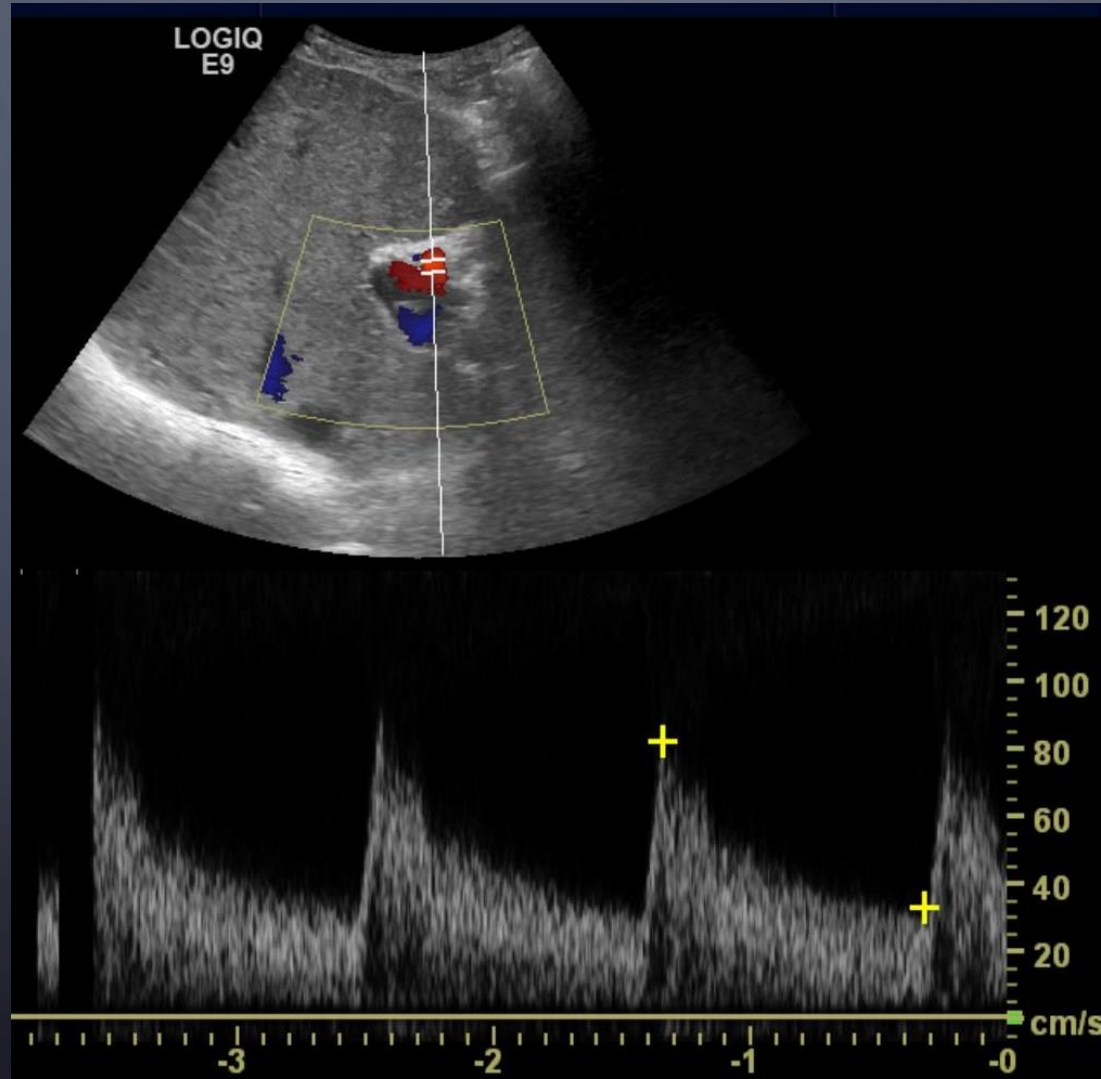
- Parenchyma: homogeneous or slightly heterogeneous
- Focal increased echogenicity may reflect contusion/haemorrhage
- No biliary duct dilatation
- If T-tube in situ - extrahepatic bile ducts may appear thick-walled
- Pneumobilia may be normal in bilioenteric anastomosis or if sphincterotomy performed
- Small volume perihepatic fluid can be normal in first 10 days

# NORMAL TRANSPLANT LIVER US

- Raised RI can be normal in first few days
- Raised RI: vasospasm, post op oedema, increased portal flow, prolonged cold ischaemia time, advanced donor age

# NORMAL HEPATIC ARTERY

- Rapid systolic upstroke with continuous diastolic flow
- RI: 0.5-0.8



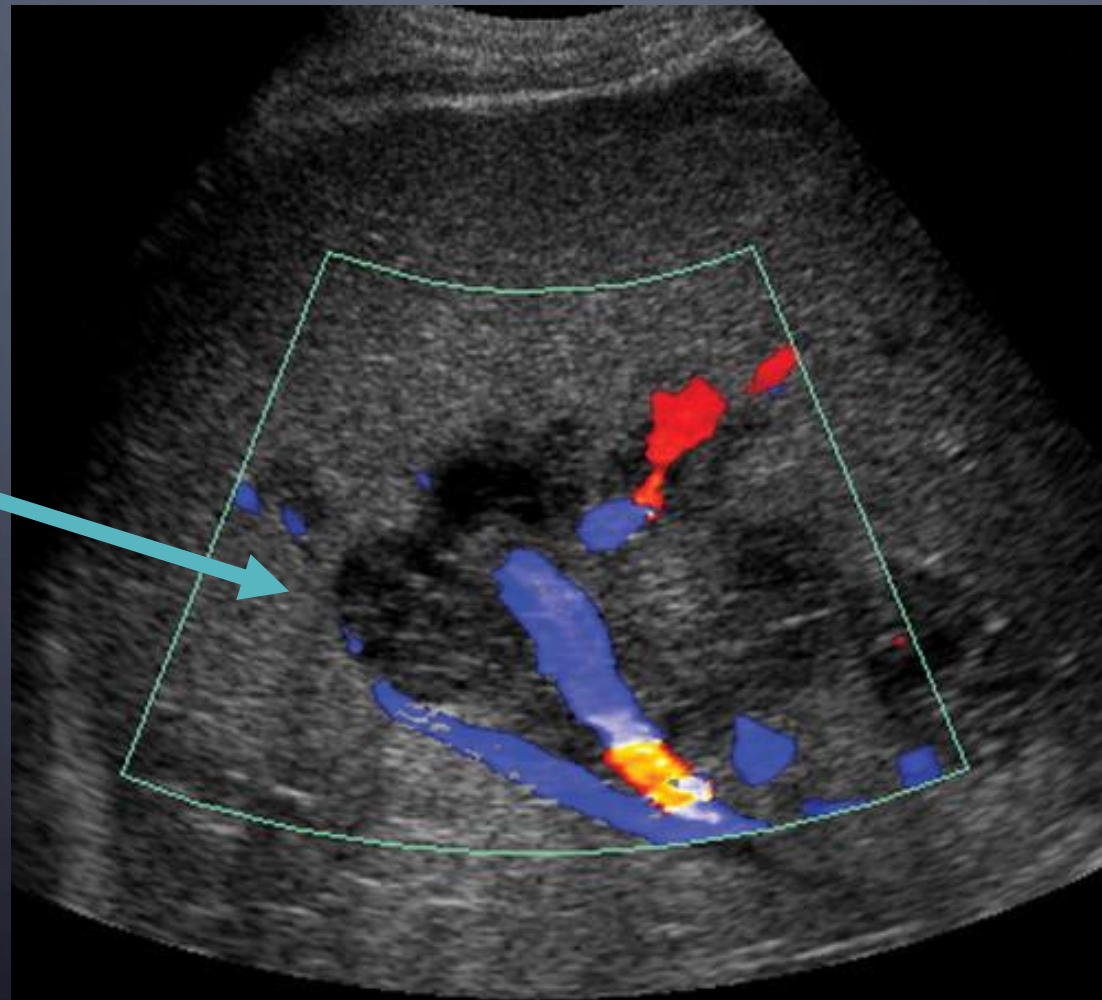
# HEPATIC ARTERY THROMBOSIS

- 8% transplants
- 60% of all vascular complications post tx
- 20-60% mortality
- Early thrombosis – first 15 days
- Delayed thrombosis – years – chronic rejection, sepsis
- Presentation: fulminant liver failure, delayed bile leak, bacteremia
- Mx: urgent revascularisation, may require re-transplant

# HEPATIC ARTERY THROMBOSIS

- Absence of flow on Doppler

- Infarcts



# HEPATIC ARTERY THROMBOSIS

- Nolten and Sproat described “syndrome of impending thrombosis”:
- 3-10 days
- Normal initial waveform
- No diastolic flow
- Dampening of systolic peak
- Total loss of hepatic arterial waveform



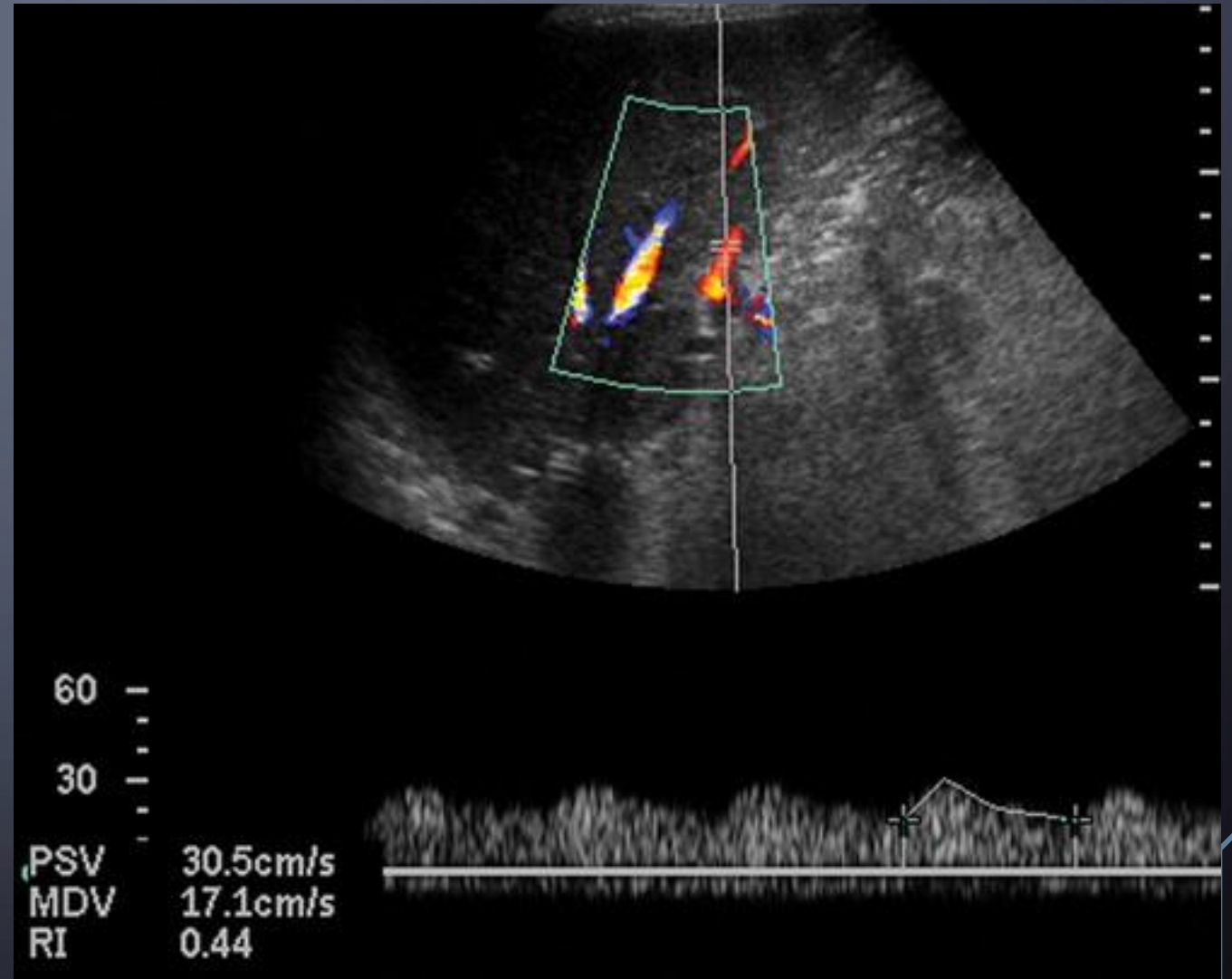
# ABNORMAL HEPATIC ARTERY— TARDUS PARVUS

- Prolonged acceleration time and decreased resistive index



# ABNORMAL HEPATIC ARTERY – TARDUS PARVUS

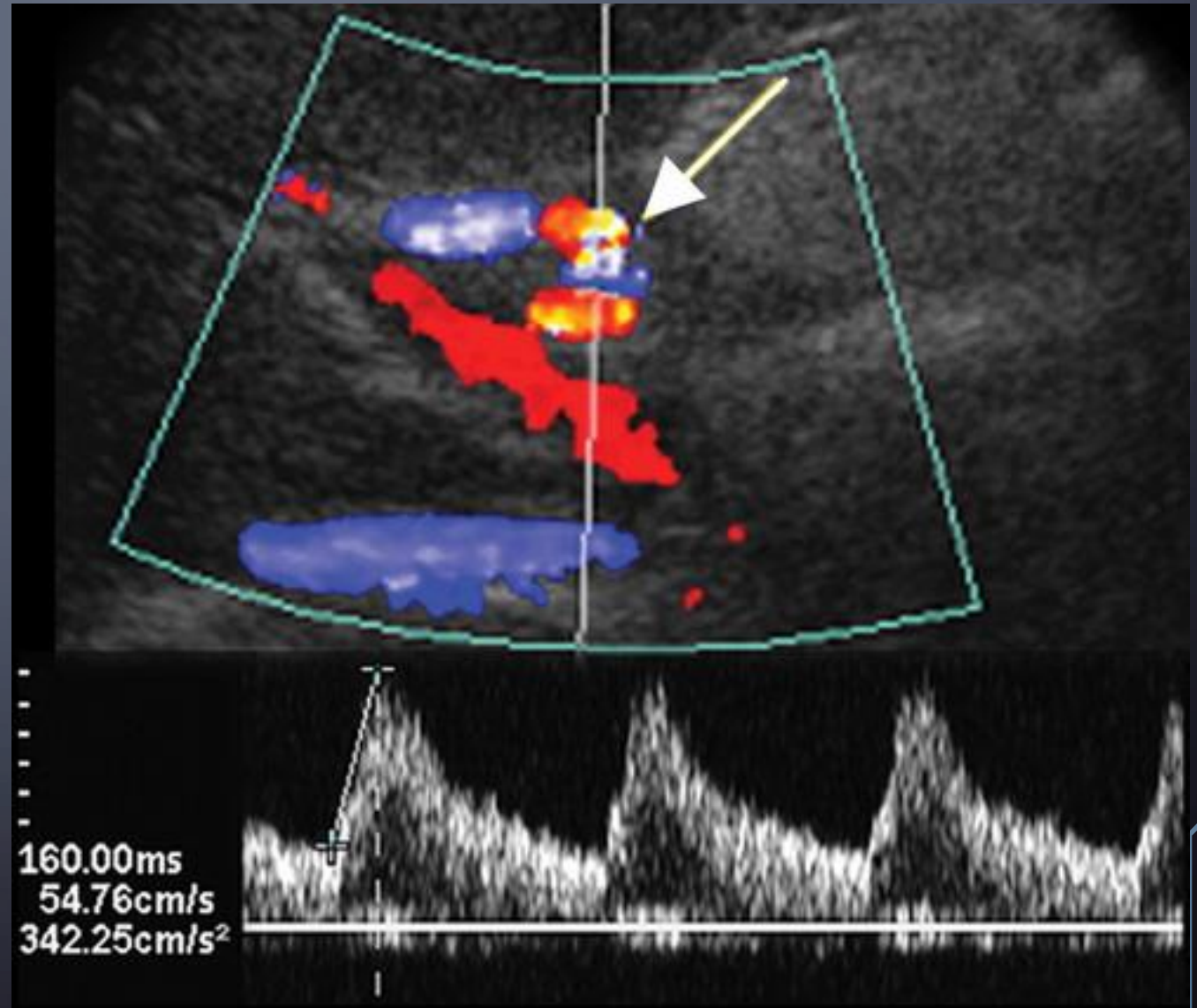
- Left intrahepatic artery – tardus parvus waveform
- Prolonged acceleration and decreased RI





# ABNORMAL HEPATIC ARTERY

- Focal stricture (arrow) with aliasing at the anastomosis
- Elevated peak velocity and spectral broadening = turbulence





# HEPATIC ARTERY PSEUDOANEURYSM

- Vascular anastomotic site
  - Secondary to infections
  - Fistula can form between aneurysm and biliary tree or portal vein
  - Treated with surgery or stent placement
- 
- US: periportal or intrahepatic cystic structure on B-mode US adjacent to/along course of hepatic artery
  - Need colour and spectral Doppler to avoid misdiagnosis (e.g. collection)

# HEPATIC ARTERY PSEUDOANEURYSM

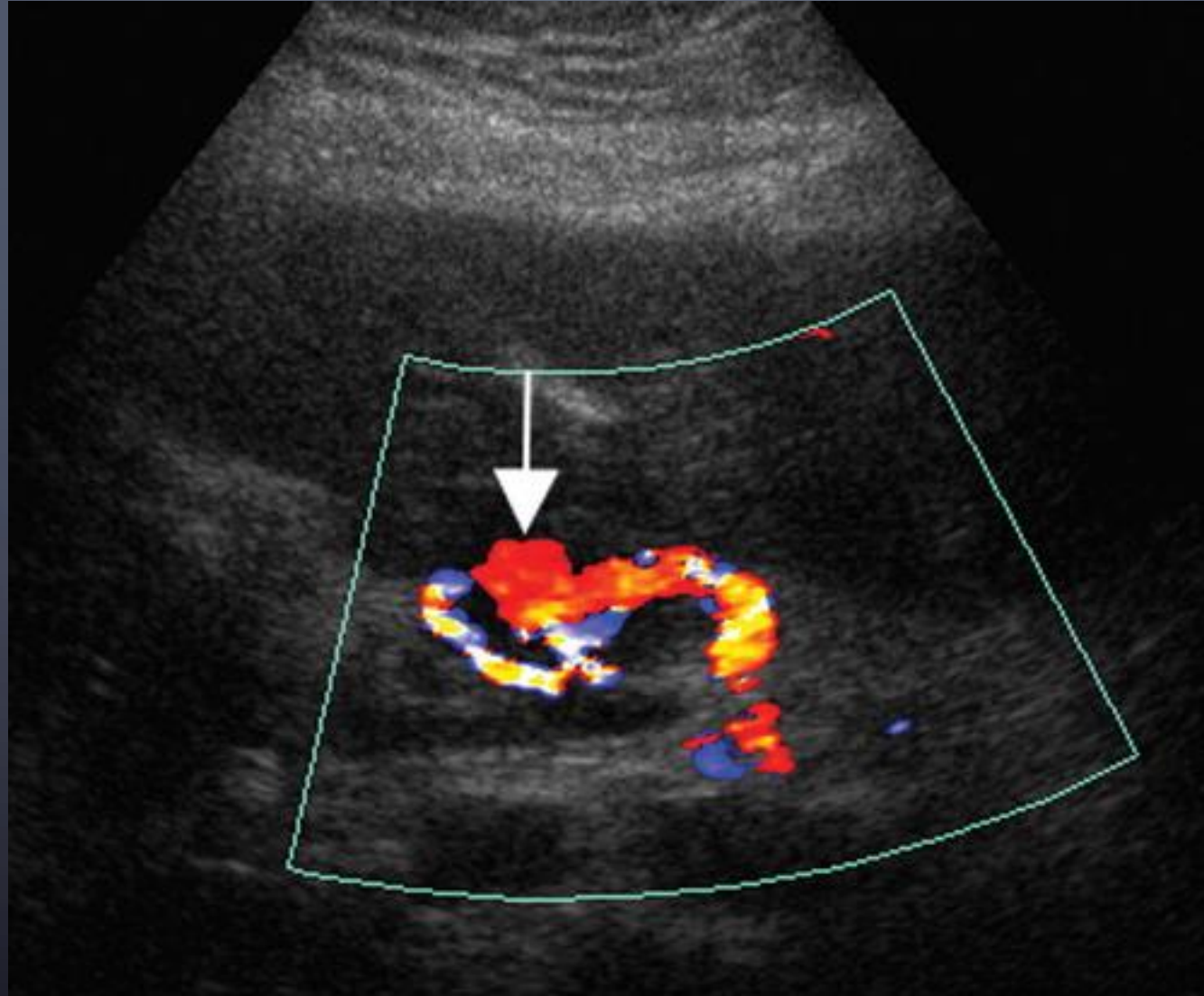
- Doppler – abnormal arterial flow
- Intrahepatic tardus-parvus waveform
- Large pseudoaneurysm – monophasic flow

# HEPATIC ARTERY PSEUDOANEURYSM

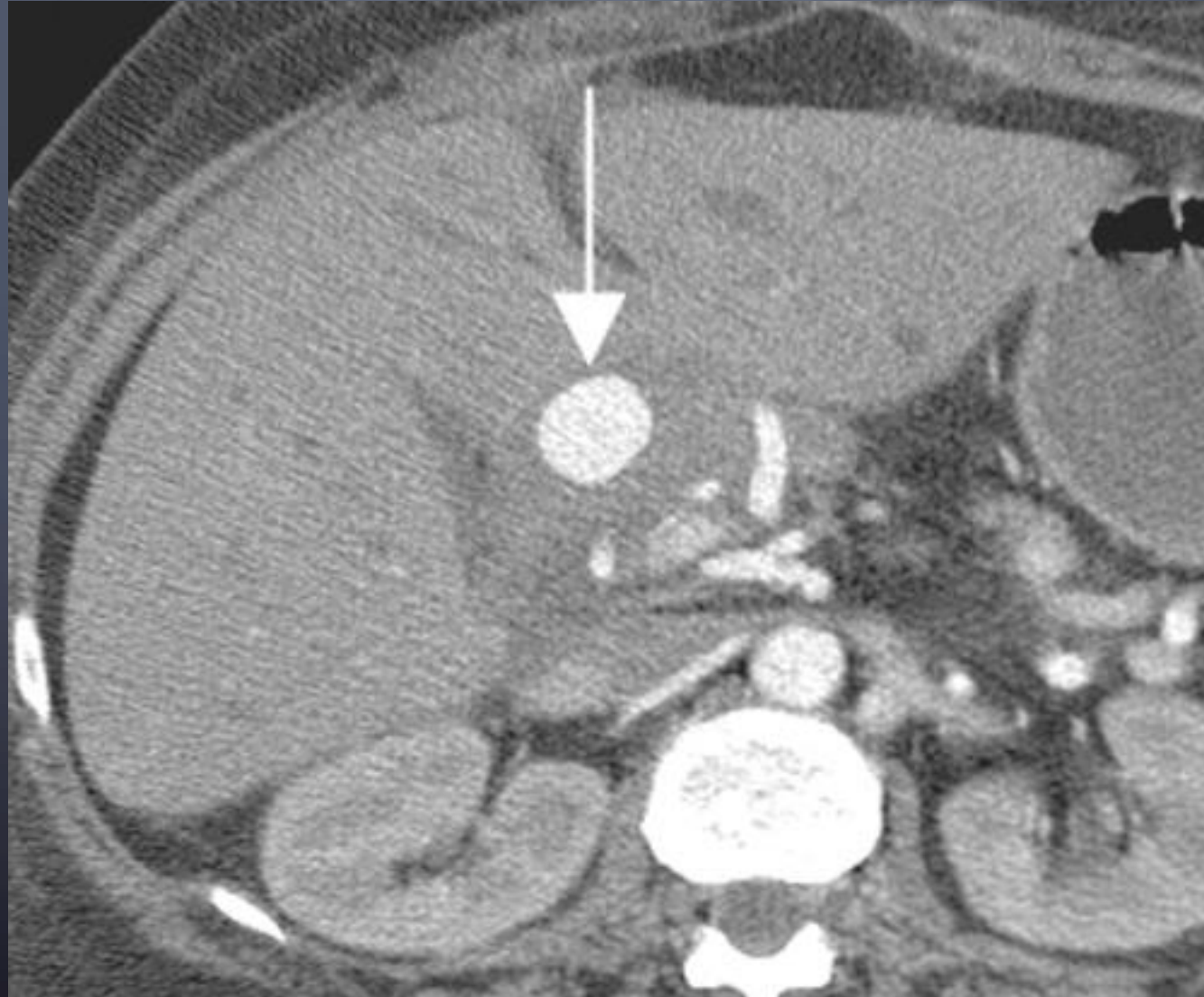




# HEPATIC ARTERY PSEUDOANEURYSM



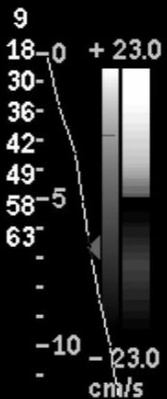
# HEPATIC ARTERY PSEUDOANEURYSM



# HEPATIC ARTERY PSEUDOANEURYSM

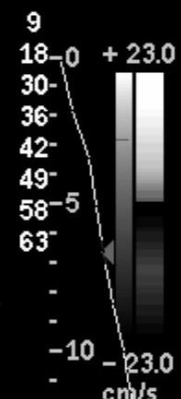
ROYAL FREE HOSPITAL C5-2 Abd/Renal 11:21:33 Fr #29 ROYAL FREE HOSPITAL C5-2 Abd/Renal 11:21:55 Fr #65 11.7cm

62% Map 1  
Med  
F 1500 Hz  
w Opt: Med V

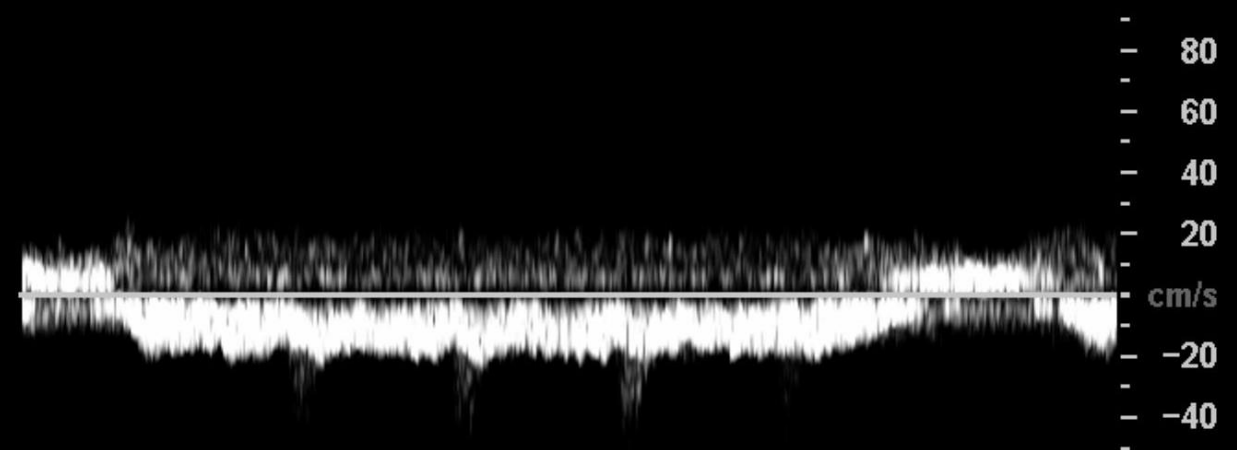


SV Angle 1°  
Dep 6.9 cm  
Size 2.0 mm  
Freq 2.5 MHz  
WF Low  
Dop 73%  
PRF 5000

62% Map 1  
Med  
F 1500 Hz  
w Opt: Med V



SV Angle 0°  
Dep 6.5 cm  
Size 2.0 mm  
Freq 2.5 MHz  
WF Low  
Dop 73% Map 2  
PRF 5000 Hz

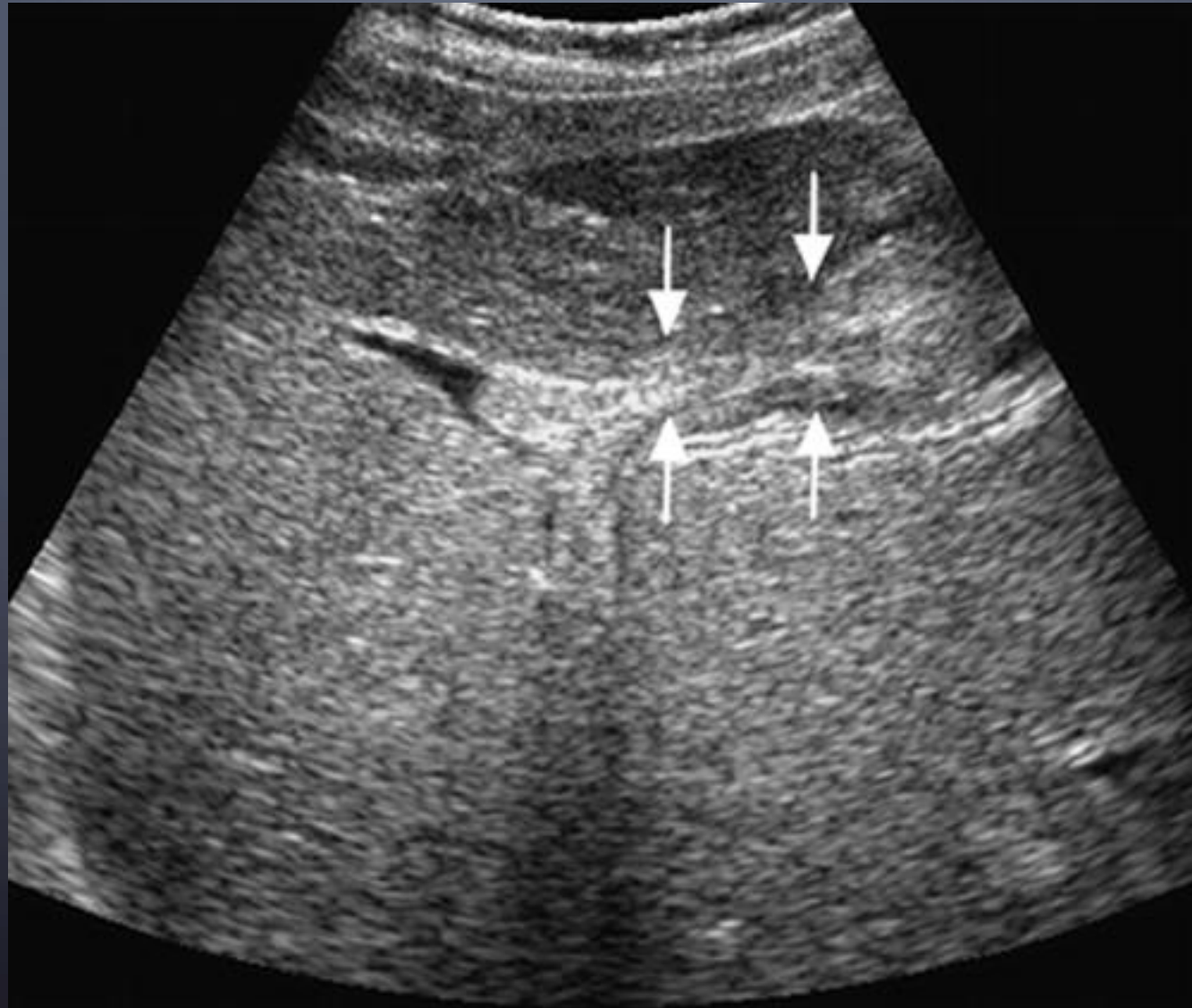




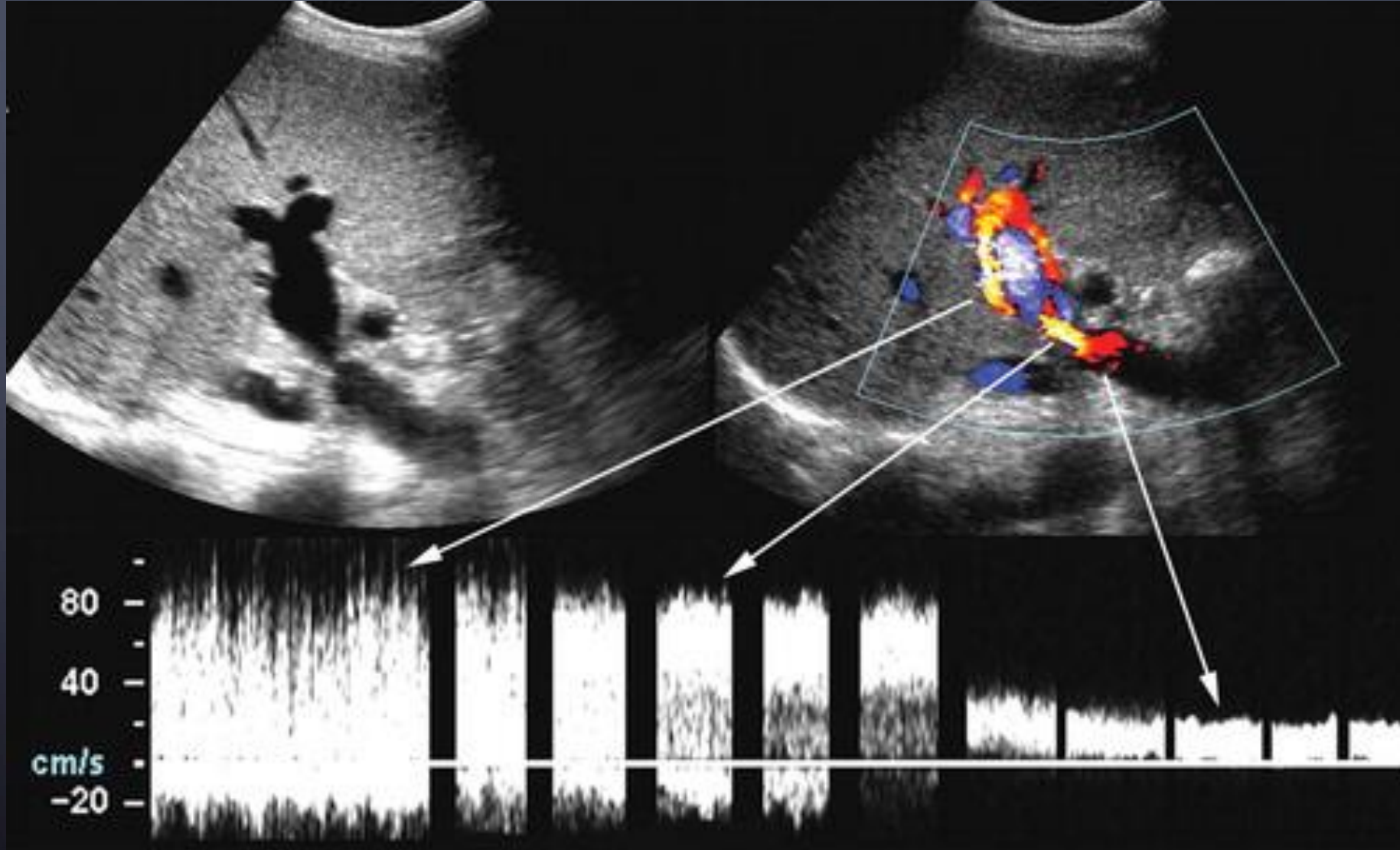
# PORTAL VEIN THROMBOSIS

- B-Mode US: intraluminal echogenic filling defect
- Acute thrombus can be anechoic and only identified as a flow defect on colour Doppler

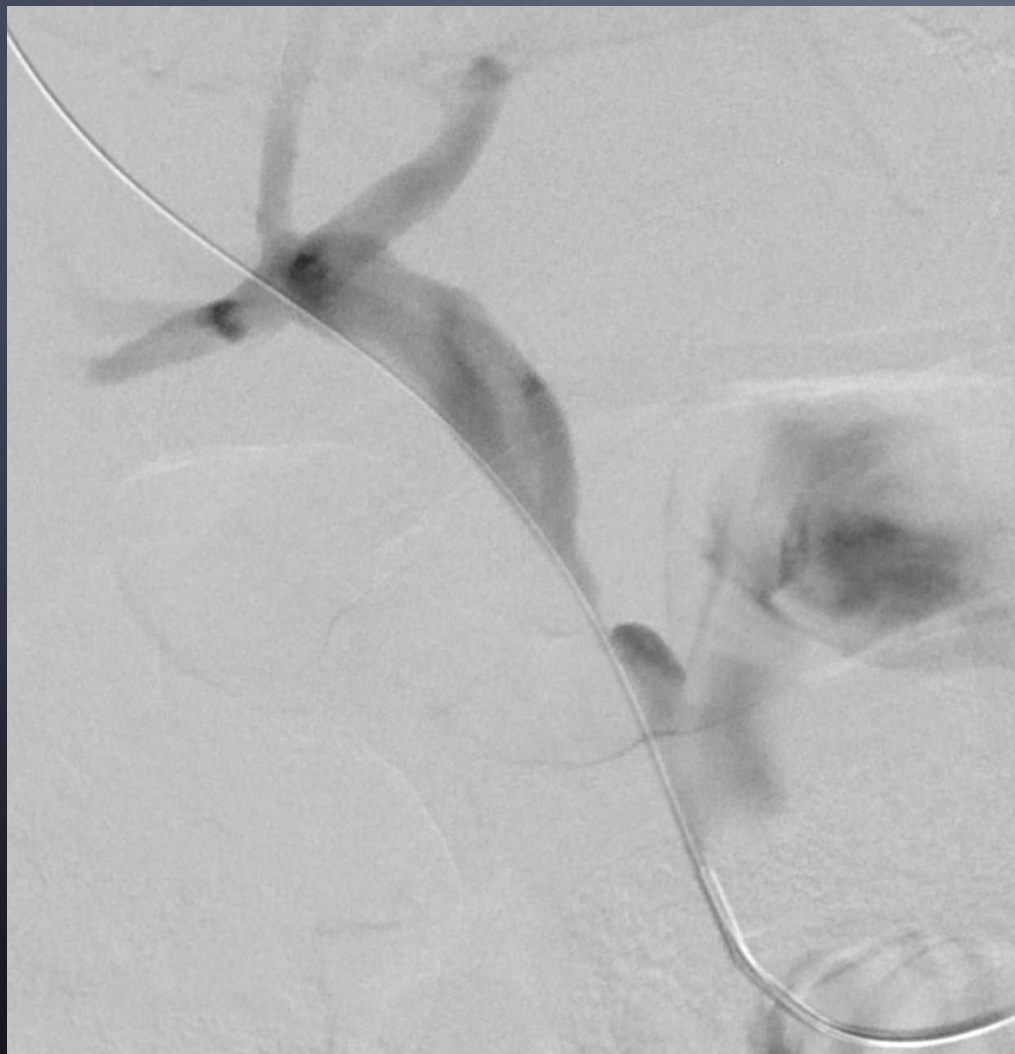
# PORTAL VEIN THROMBOSIS



# PORTAL VEIN STENOSIS



# TRANSPLENIC PORTAL VEIN DILATATION




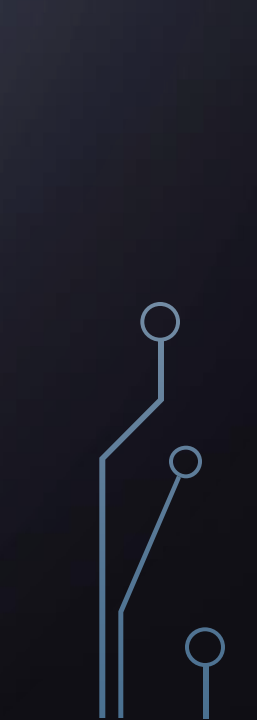


# PORTAL VEIN STENOSIS

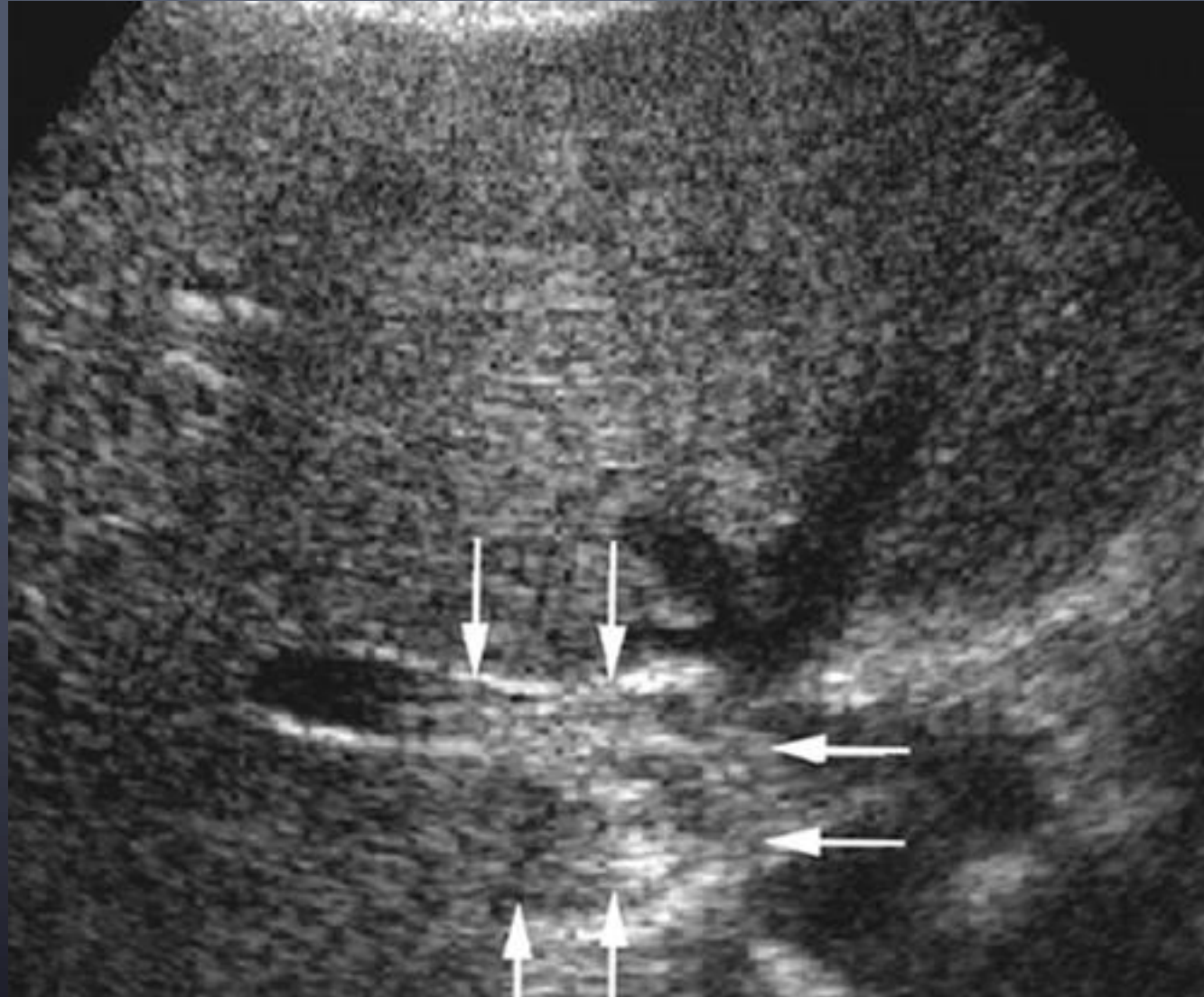




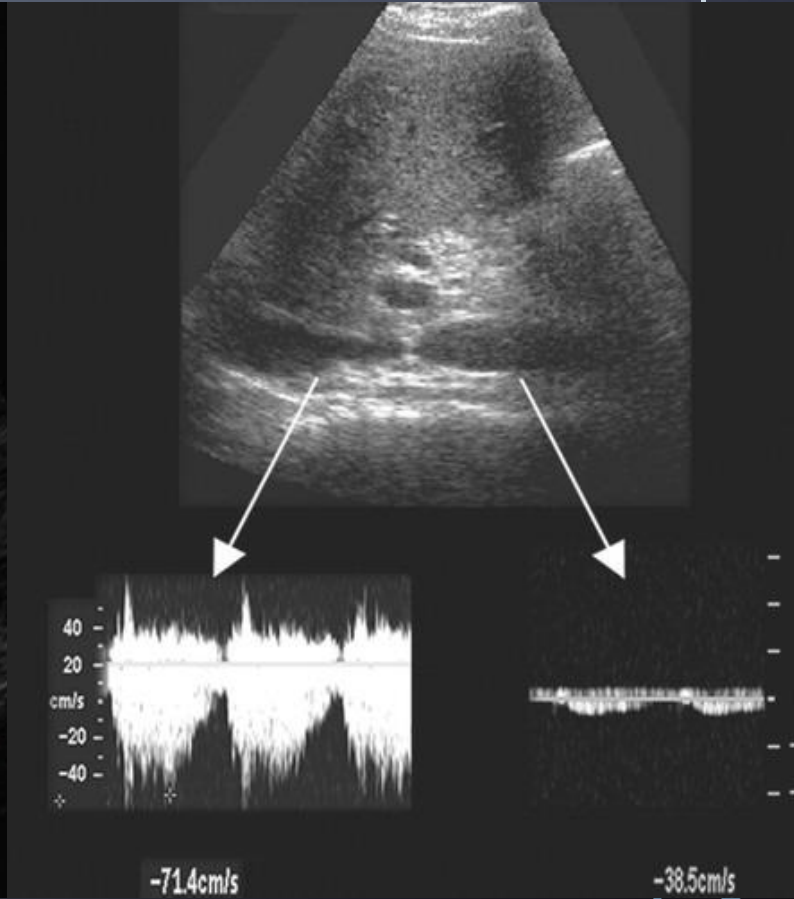
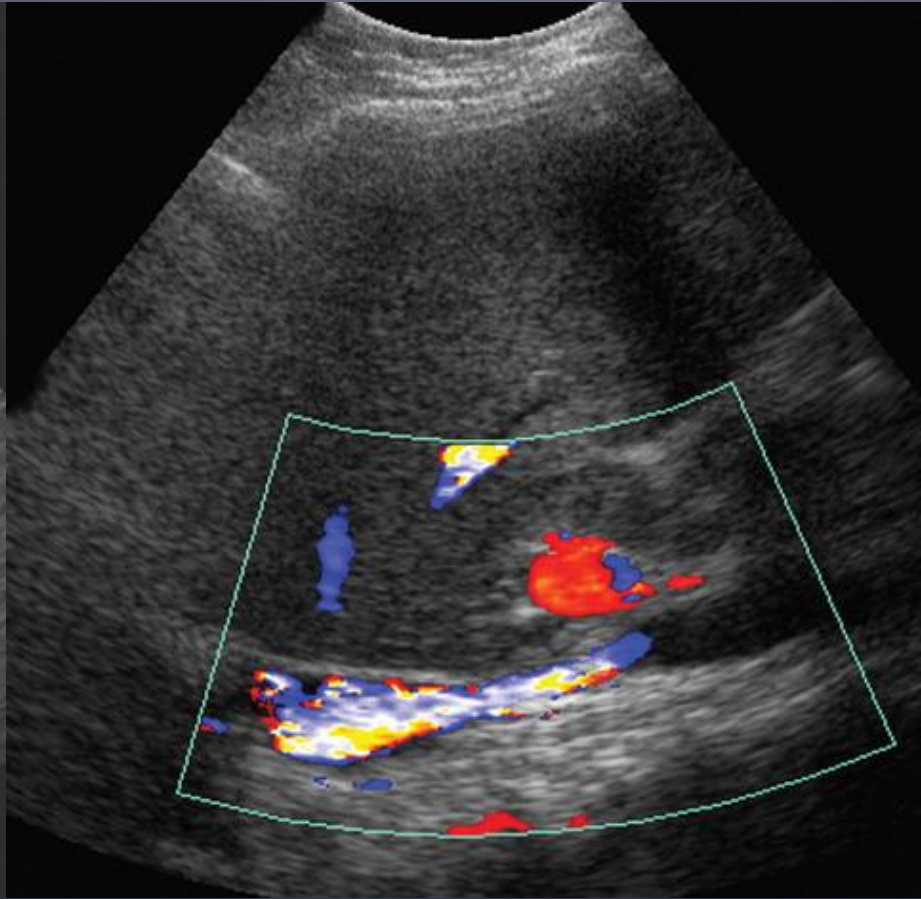
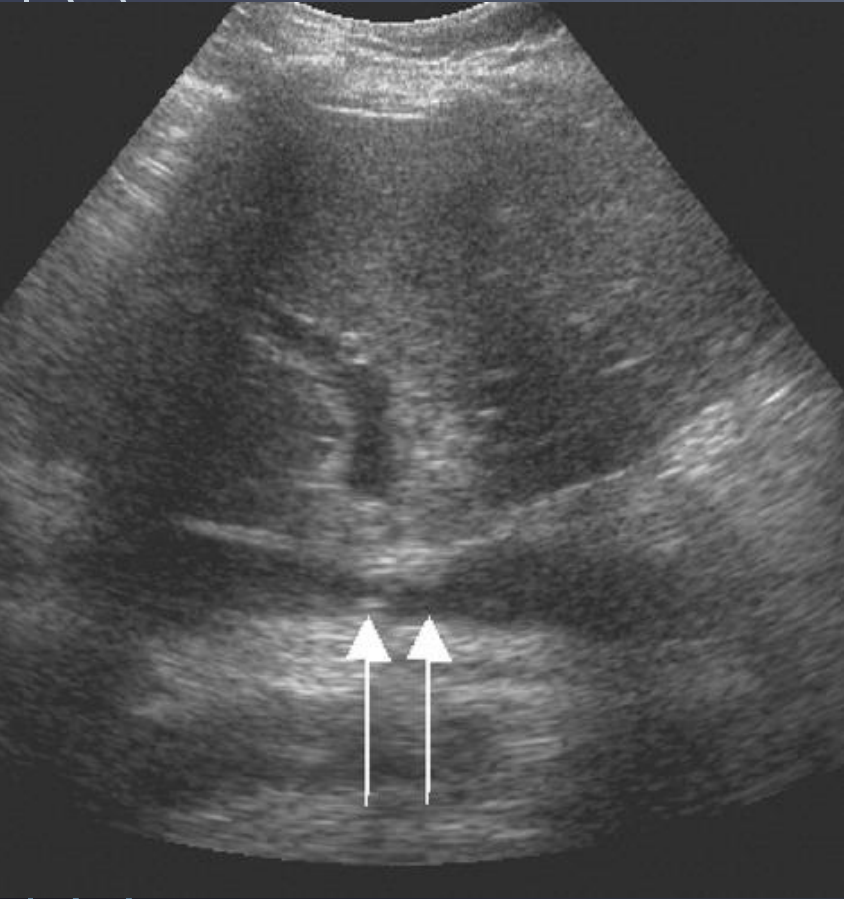
# IVC/HV COMPLICATIONS

- Anastomotic IVC stenosis
  - Kinking of the hepatic vein
  - Budd Chiari
- 
- 

# IVC THROMBOSIS



# IVC STENOSIS





# BILIARY COMPLICATIONS

- 25% patients
- Biliary tree – dependent on HA supply
- Bile leak
- Anastomotic stricture
- Non-anastomotic stricture
- PSC recurrence
- Calculus

# BILIARY COMPLICATIONS

- Leak: perihepatic fluid collection
- Anastomotic stricture: dilated intrahepatic ducts and common duct dilatation to the level of the anastomosis. Distal to stricture, common duct will be normal in calibre
- Non-anastomotic stricture: secondary to ischaemia from HA compromise. Focal segmental intrahepatic or hilar duct dilatation with no obvious mass
- If IHD – evaluate hepatic artery closely, and if previous PSC – consider recurrence

# INTRADUCTAL CALCULUS



# ANASTOMOTIC BILIARY STRICTURE




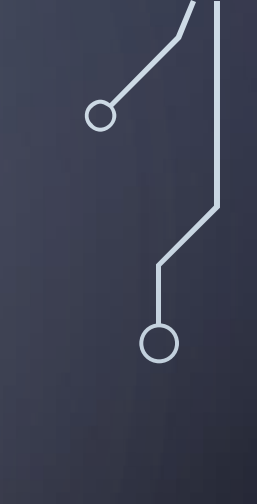
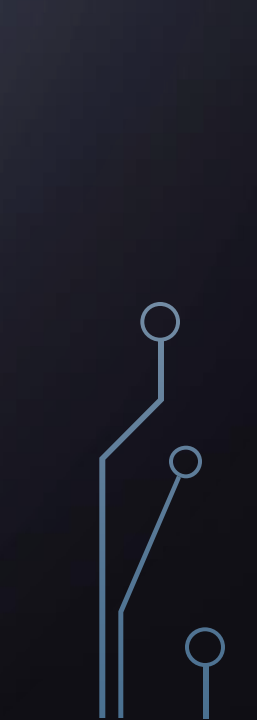
# RECURRENT PSC








# MALIGNANCY

- HCC recurrence
  - Disease in the transplant liver graft
  - New malignancy
  - Post transplant lymphoproliferative disorder (PTLD)
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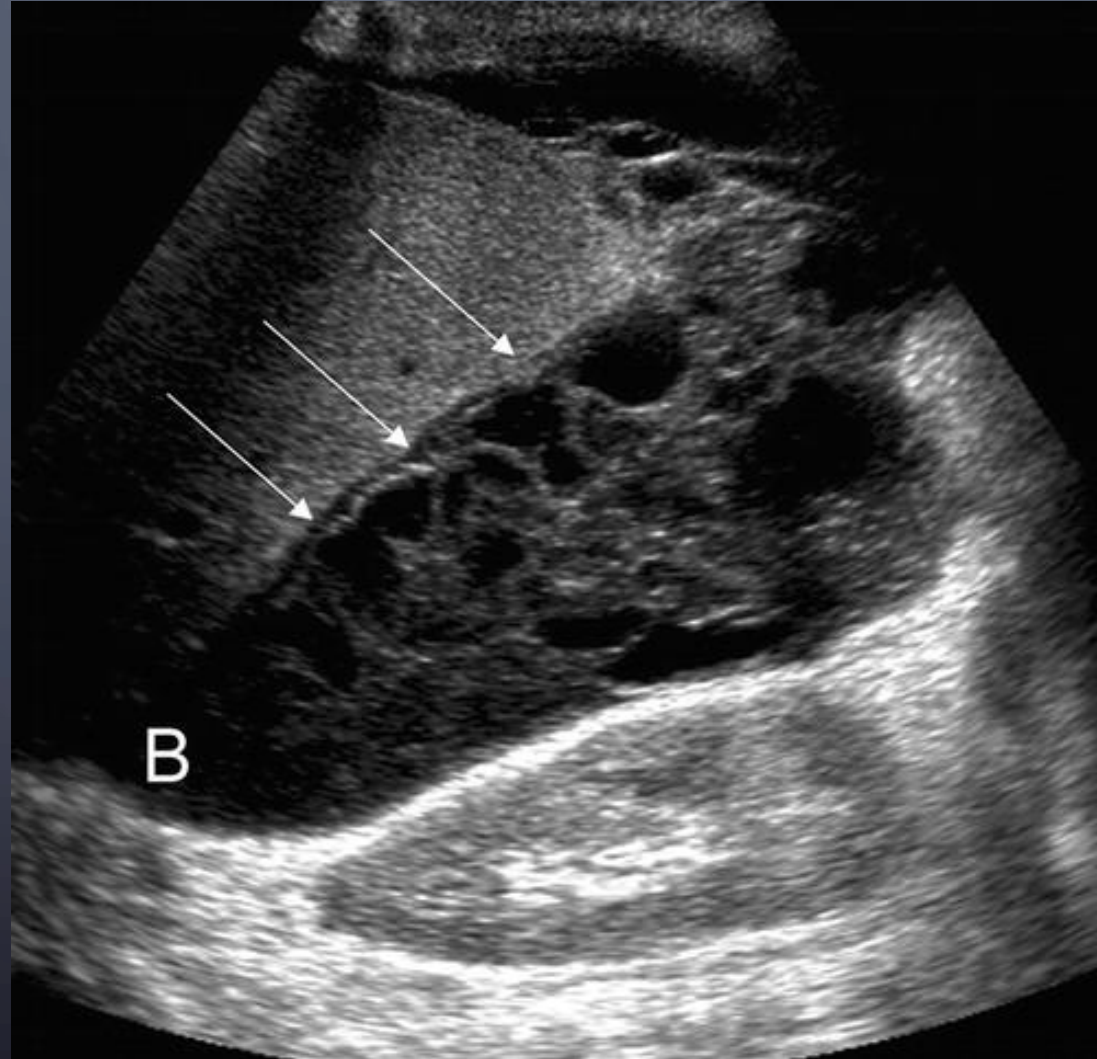


# COLLECTIONS

- Bile leak
  - Haematoma
  - Seroma
  - Abscess
  - Ascites
- 



# HAEMATOMA



# BILE LEAK



# REFERENCES

- Ultrasound in Liver Transplant – Dr Dominic Yu
- Mohit Achanta, TeachMeSurgery, <https://teachmesurgery.com/transplant-surgery/organ-transplantation/liver/>
- <https://radiologykey.com/imaging-of-liver-transplant/>
- **US of Liver Transplants: Normal and Abnormal**  
<https://pubs.rsna.org/doi/10.1148/rg.235035031#F3A> Slides: 19, 21, 24-26, 29-31, 34, 35, 37, 39, 40, 43-45, 48



The image features a dark blue gradient background with white, stylized circuit board traces in the corners. These traces consist of straight lines of varying lengths and angles, ending in small white circles, resembling electronic components or connections. The traces are located in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text.

THANK YOU