

Medical Expert Training
in Liver Surgery

Intraoperative US of the Liver: Techniques and Clinical Application

Marco Catena

Hepato-biliary Surgery
Scientific Institute San Raffaele Hospital
Milan



OLYMPUS



Medical Expert Training

Olympus does not assume any liability for the completeness, accuracy and up-to-dateness of the information provided by the speaker. Liability claims against Olympus related to damages of a material or non-material nature which have been caused due to the use or non-use of the information provided by the speaker or due to the use of incorrect an/or incomplete information are strictly excluded.

This presentation created by Marco Catena including its content are protected by copyright. You are not authorized to duplicate, distribute, reproduce or process, to make it publicly accessible or to perform this presentation or its contents without prior written consent of the owner of contents.

Role of Intraoperative US

IntraOperative UltraSound (IOUS) of the liver provides the operating surgeon with useful real-time diagnostic and staging information

- ◆ Intraoperative stadiation of parenchimal disease
 - ◆ Mapping of tumor nodules
 - ◆ Localization of impalpable lesion deep in the liver
- ◆ Definition of intrahepatic pedicle anatomy and relationship between tumor and main intrahepatic vascular structures
 - ◆ Tumor infiltration of vascular structures
 - ◆ Tumor infiltration of biliary tracts
- ◆ Resection guidance
 - ◆ Definition of type of liver resection
 - ◆ Ensure radical resection

Role of Intraoperative US

IntraOperative UltraSound (IOUS) of the liver provides the operating surgeon with useful real-time diagnostic and staging information

- ◆ Liver biopsy guidance
- ◆ Radio-frequency ablation of neoplasm deep in liver parenchyma

IOUS - Diagnosis

- ◆ The impact of IOUS on the operative decision-making, when compared with pre-operative strategy, is reported to be around 18-29% of cases

1. Donadon M., Costa G., Torzilli G. State of art of Intraoperative ultrasonography in liver surgery . Current use for staging and resection guidance. *Ultraschall in Med* 2014; 35 (6): 500-514
2. Donadon M., Procopio F., Torzilli G. Tailoring the area of hepatic resection using inflow and outflow modulation. *World J Gastroenterol* 2013; 19 (7): 1049-1055
3. Van Vledder MG, Pawlik TM, Munireddy S et al. Factors determining the sensitivity of intraoperative US in detecting colorectal metastases in the modern era. *Ann Surg Oncol* 2010;17(10): 2756-2763

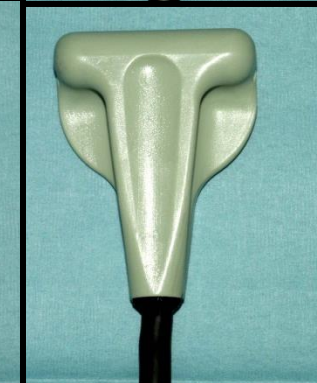
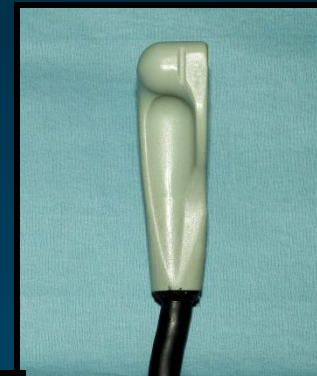
Intraoperative US

Technical aspects

◆ Equipment

◆ Ultrasound system

- ✓ Mobile, small dimensions
- ✓ 19'' High resolution monitor
- ✓ Printer
- ✓ B-mode, Color Doppler flow



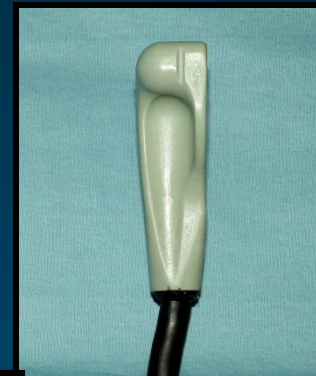
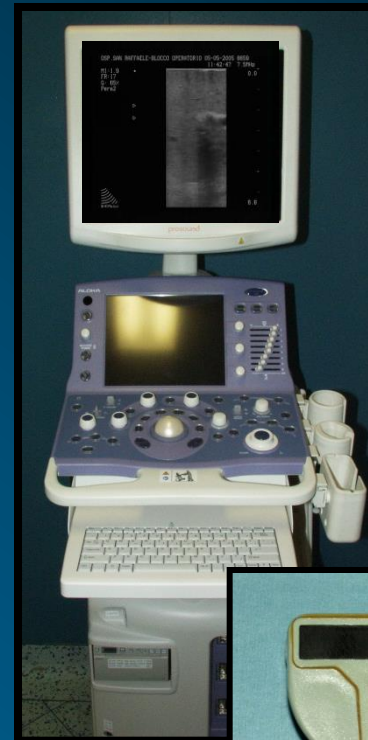
Intraoperative US

Technical aspects

◆ Equipment

◆ Laparotomic probe

- ✓ Low-temperature hydrogen peroxid gas plasma sterilization (*Sterrad*)
- ✓ T-shaped transducer (fit comfortably against the palm of the hand and between fingers)
- ✓ Scanning range: 5 - 7.5 MHz
- ✓ Linear scanning



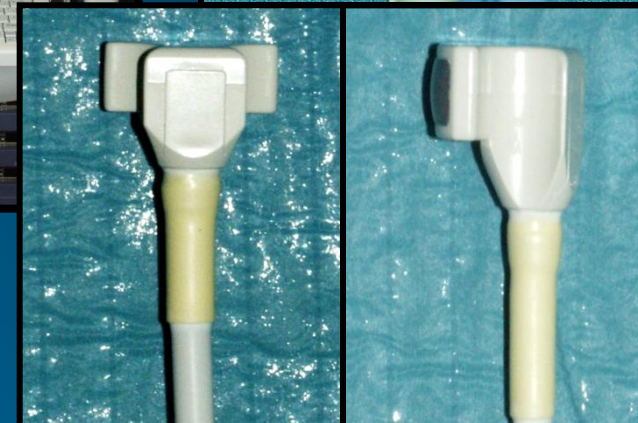
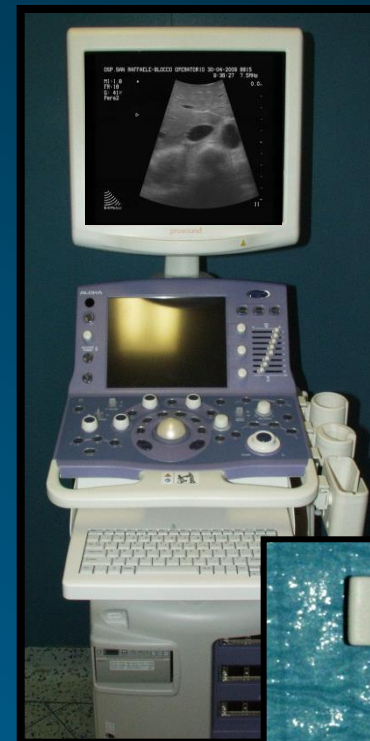
Intraoperative US

Technical aspects

◆ Equipment

◆ Laparotomic probe

- ✓ Low-temperature hydrogen peroxid gas plasma sterilization (*Sterrad*)
- ✓ T-shaped transducer
- ✓ Scanning range: 5 - 13 MHz
- ✓ Convex scanning



Intraoperative US

Technical aspects

Linear scanning



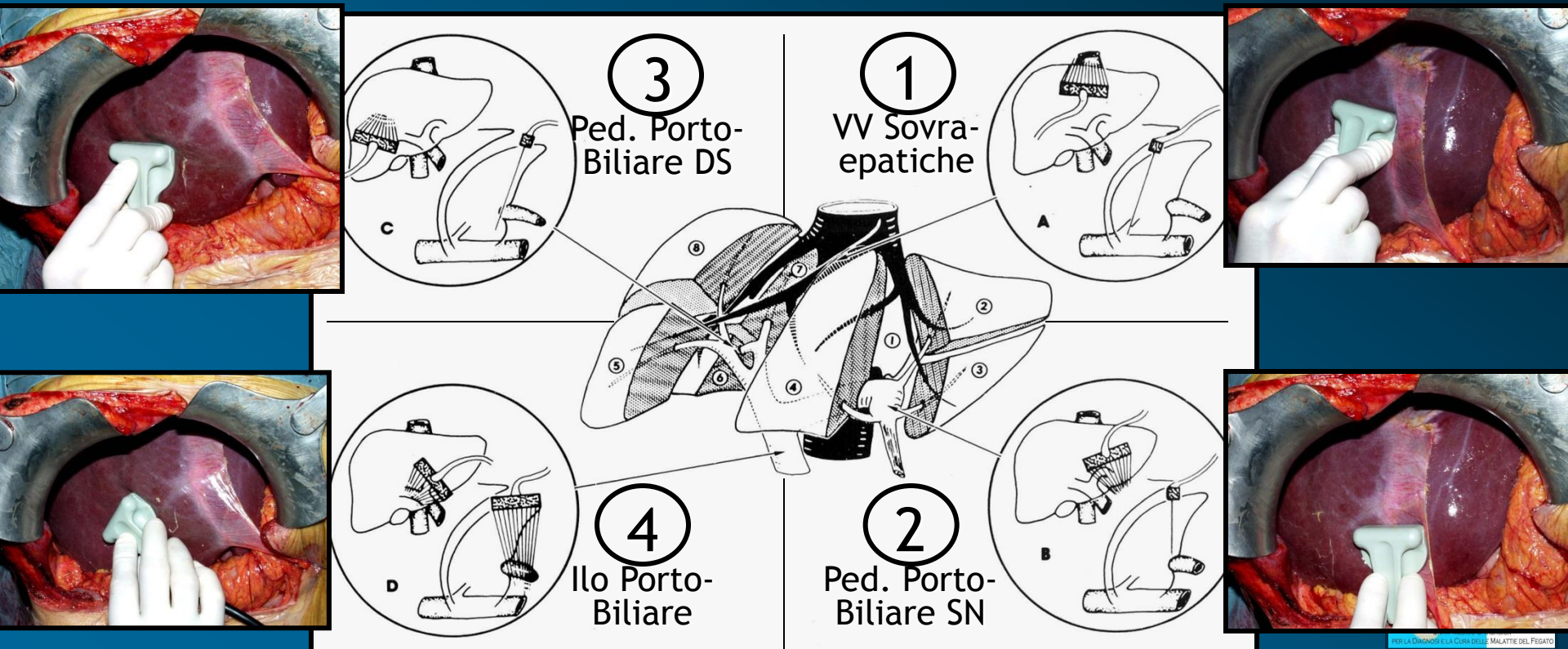
Convex scanning



IOUS – Liver anatomy

Examination technique

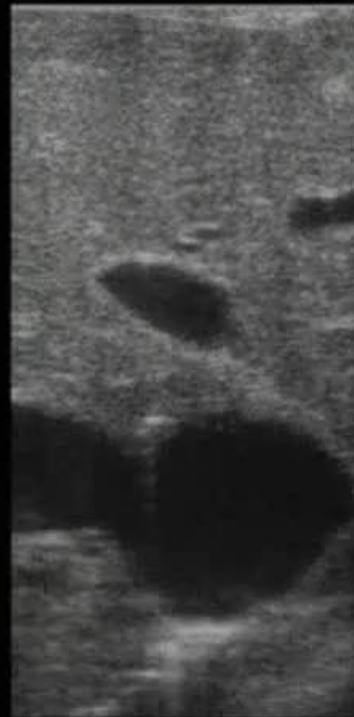
- ◆ Incomplete mobilization of the liver
- ◆ Probe in contact with liver surface
- ◆ Standardized exploration to identify biliary and vascular pedicles



Caval confluence and anatomy of hepatic veins

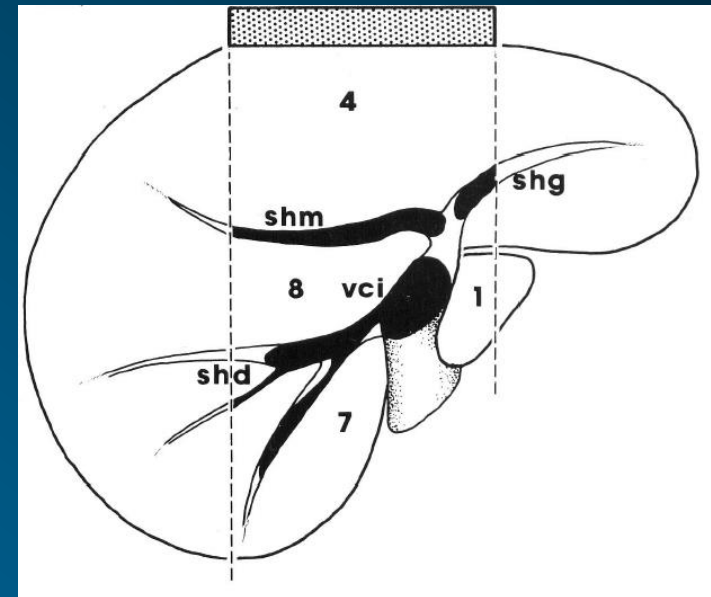
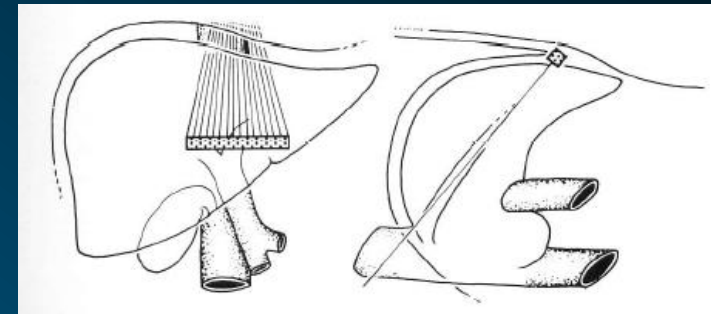
Transverse position of the probe angled towards heart

OSP.SAN RAFFAELE-BLOCCO OPERATORIO 12-05-2005 8659
 9:25:11 7.5MHz
 MI:1.9
 FR:60
 G: 81%
 Pers2



0.0

6.8



Caval confluence and anatomy

Transverse position of the probe ang



OSP. SAN RAFFAELE-BLOCCO OPERATORIO 30-04-2009 8815
9:36:27 7.5MHz

MI: 1.8
FR: 18
G: 41%
Pers2



Anatomy of hepatic veins

Transverse position of the probe angled towards heart

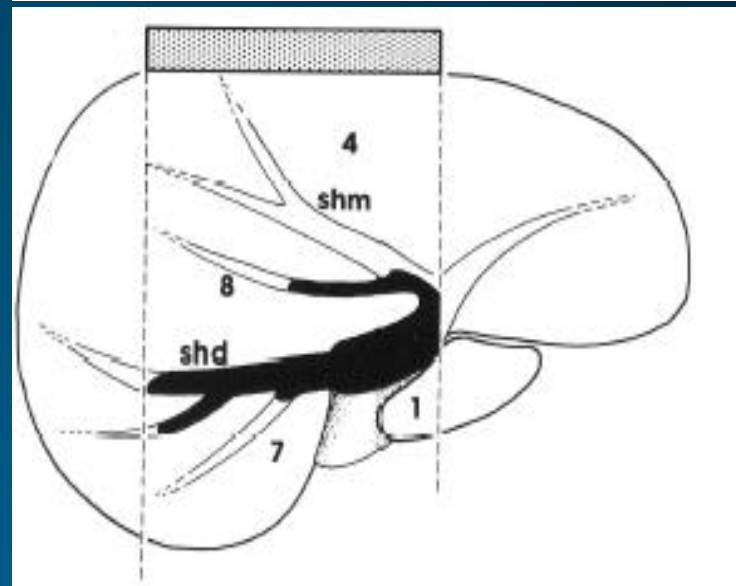
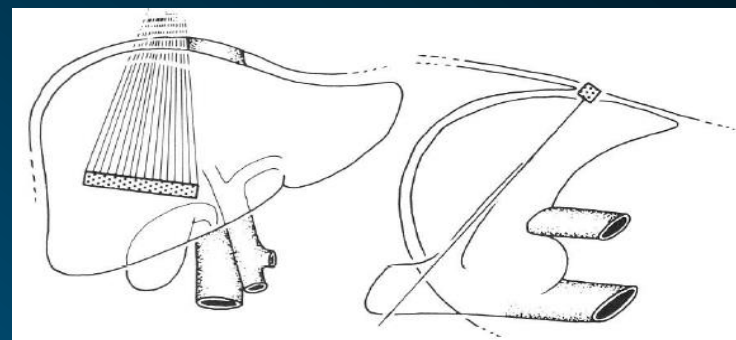
OSP. SAN RAFFAELE-BLOCCO OPERATORIO 28-04-2005 8659
13:24:49 7.5MHz

MI: 1.9
FR: 34
G: 53%
Pers2



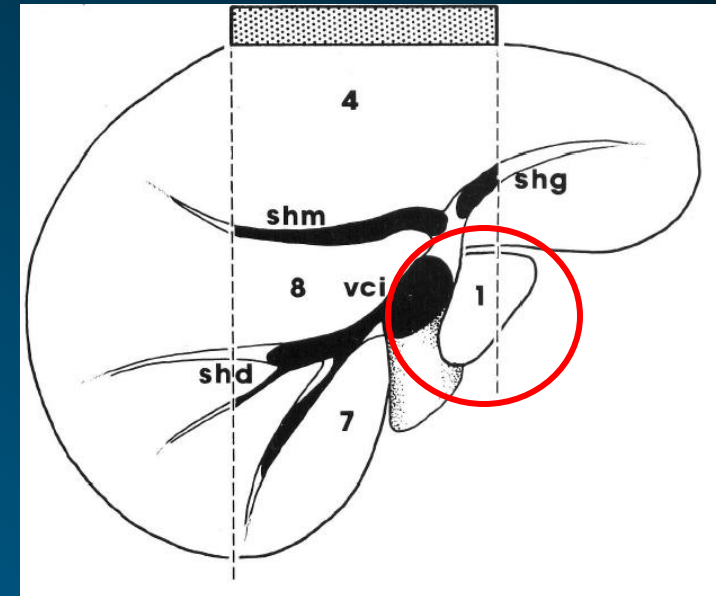
0.0

6.8



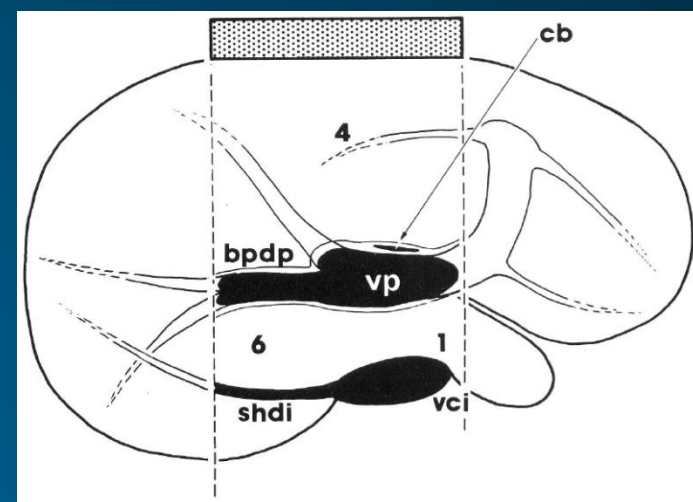
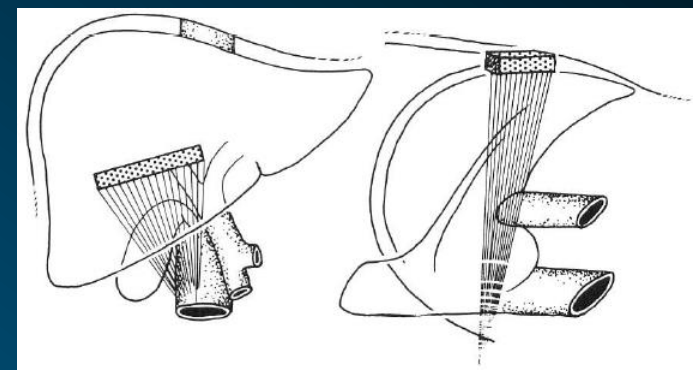
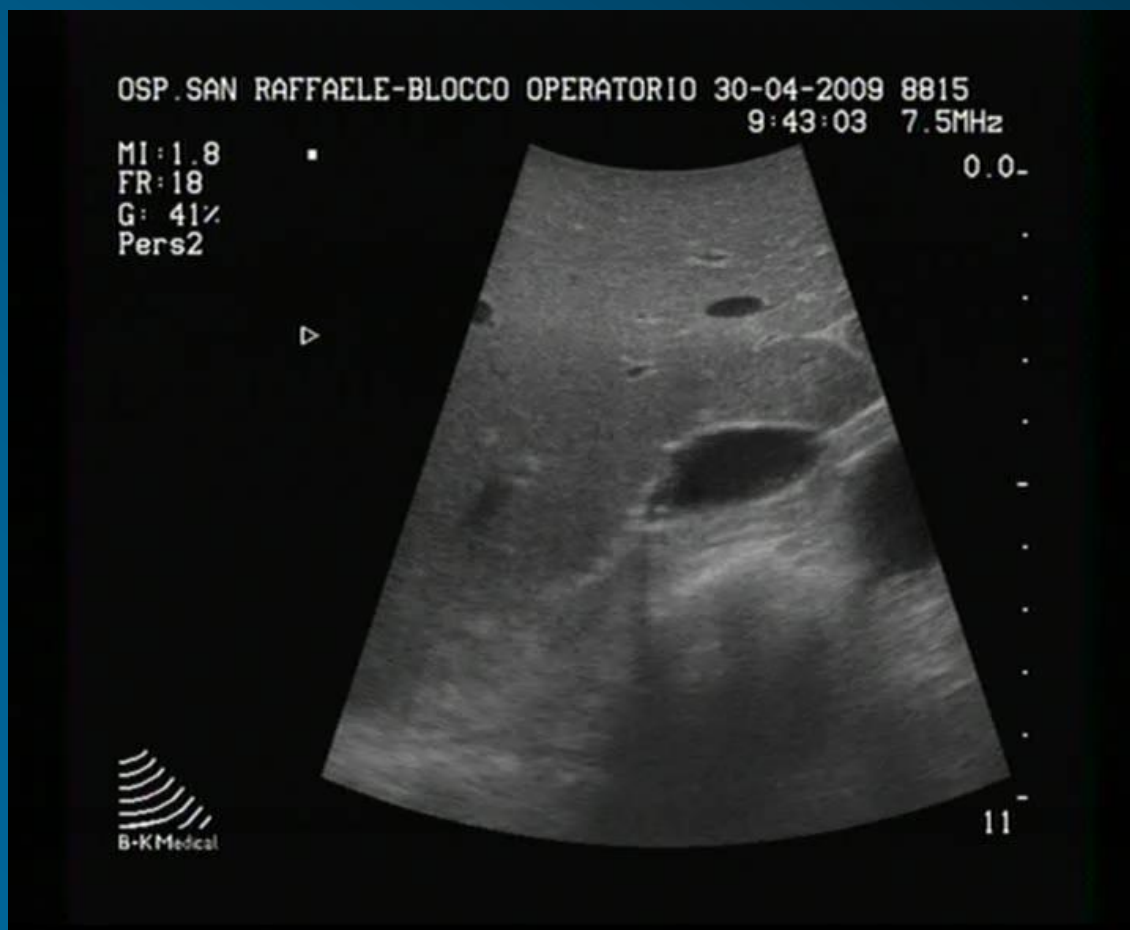
Spigelian lobe and Arantius' ligament

Transverse position of the probe angled towards porta hepatis



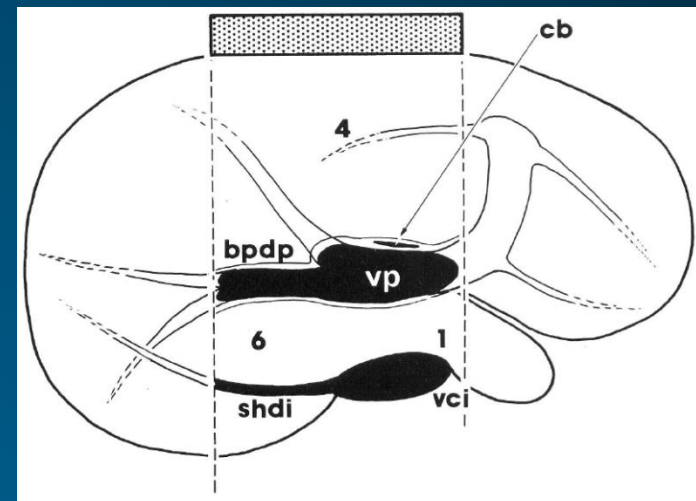
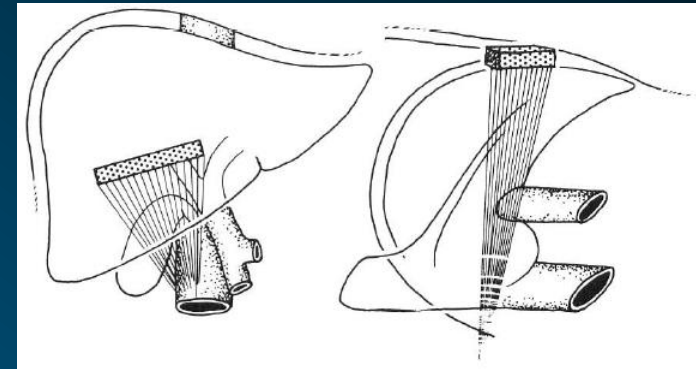
Portal bifurcation

Transverse position of the probe angled towards porta hepatis



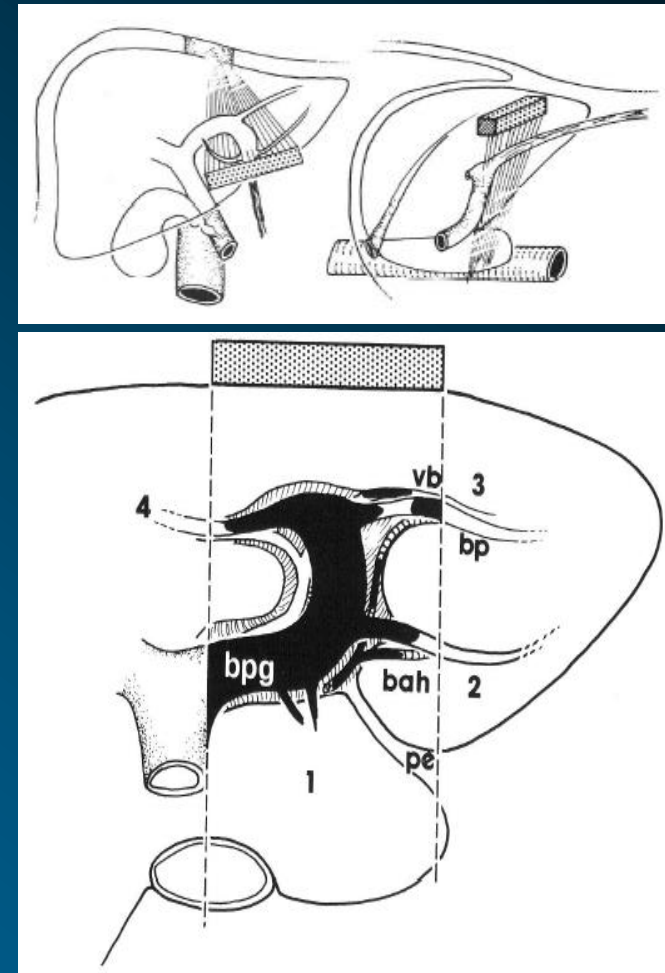
Portal bifurcation and Right Portal Branch

Transverse position of the probe angled towards porta hepatis



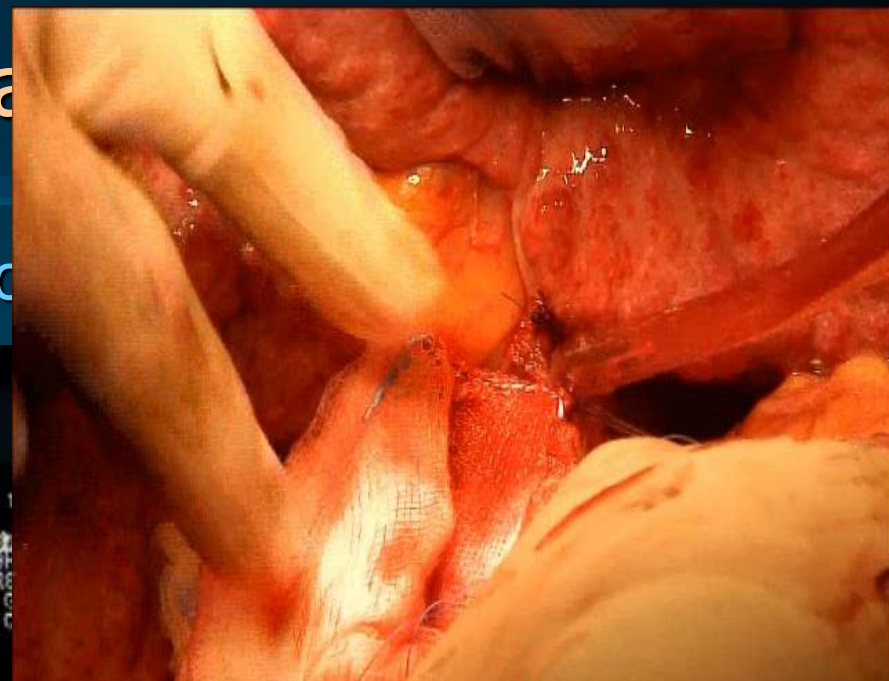
Left Portal Branch and Rex Recess

Transverse position of the probe over round ligament

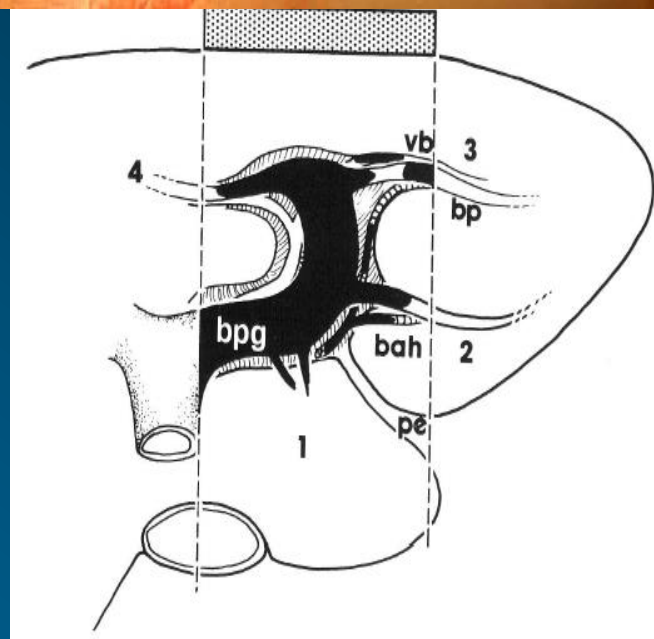


Left Portal Branch and

Transverse position of the pro

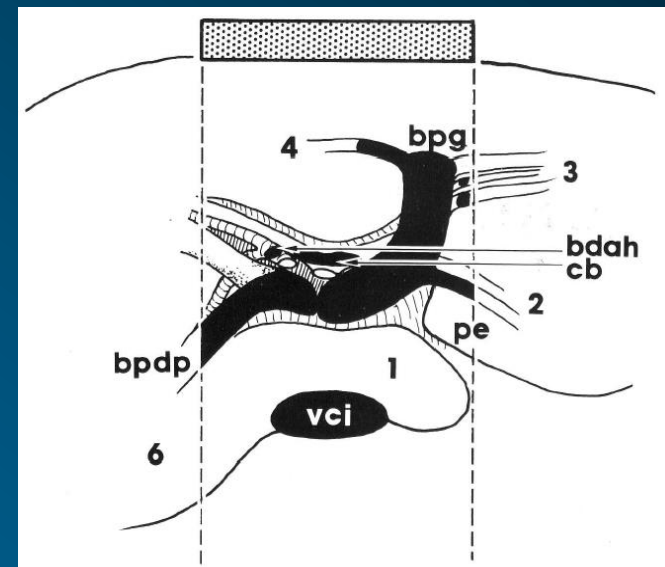
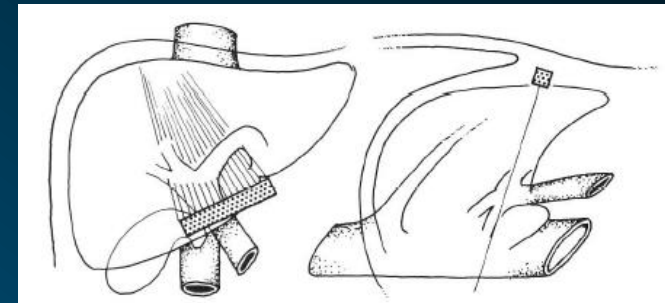
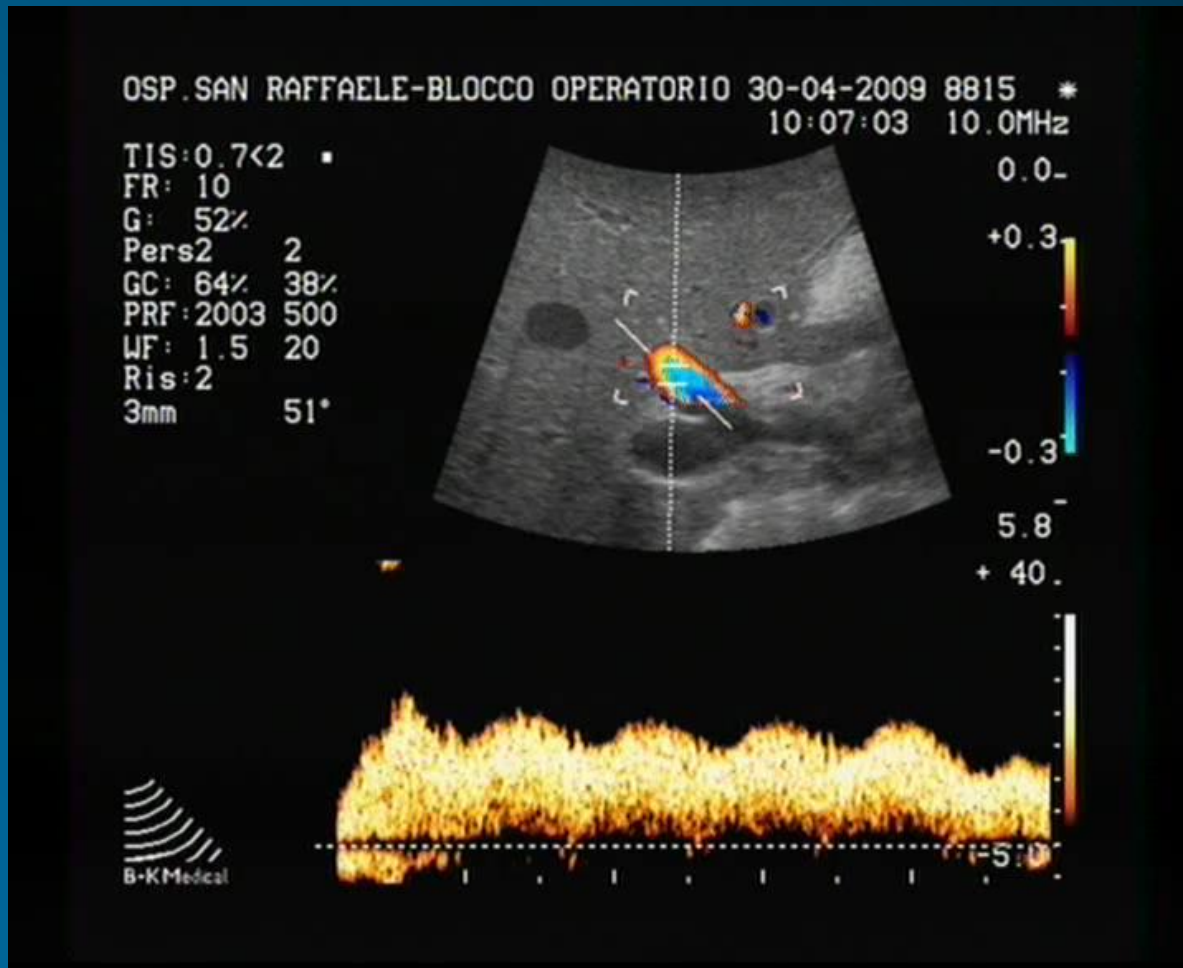


ALOKA FOND. SAN RAFFAELE No ID Y 19-03-12 11:17:33
MI -0.67 TIB< 0.4



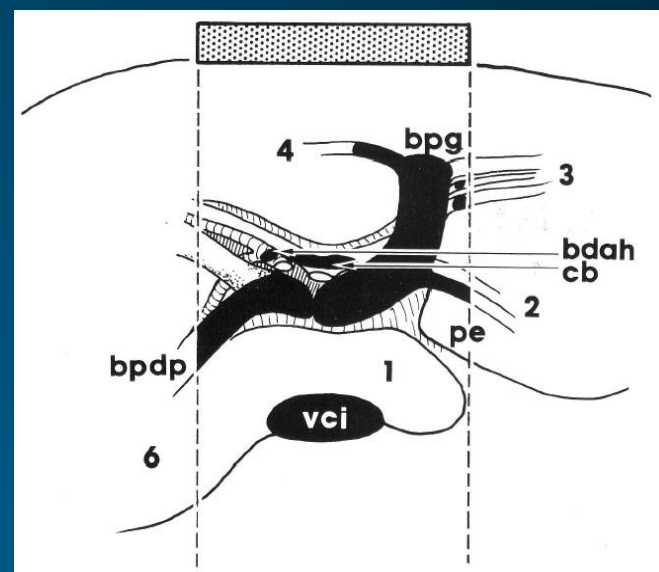
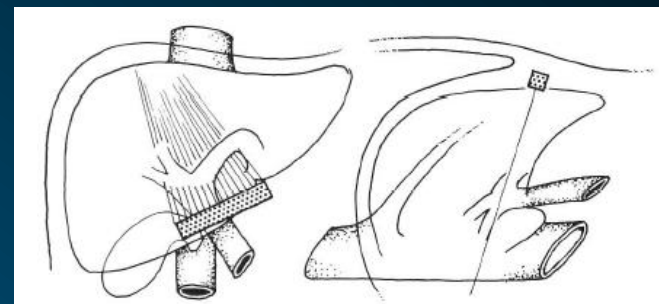
Porta Hepatis – Flow analyses

Transverse position of the probe angled towards porta hepatis



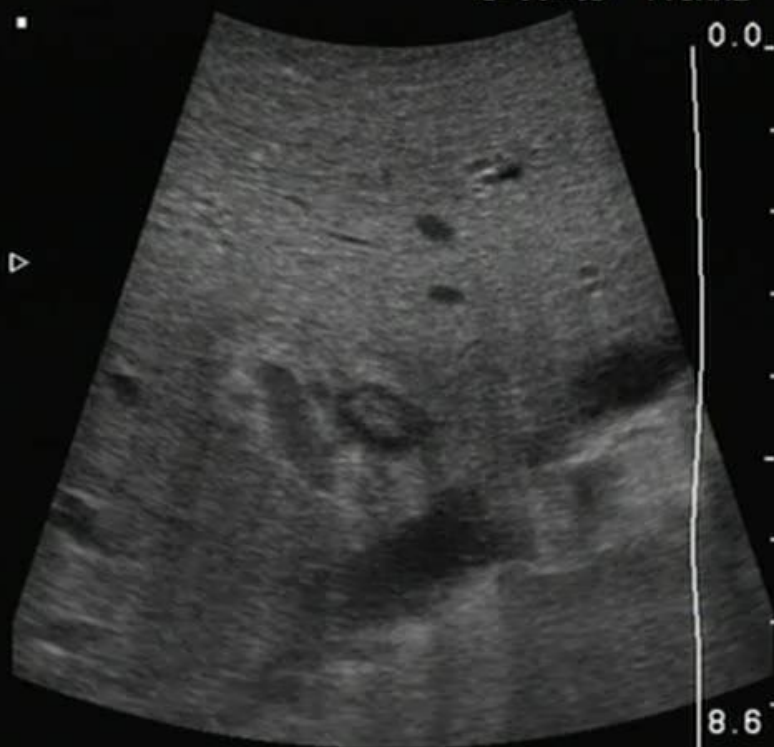
Porta Hepatis – Inflow analyses

Transverse position of the probe angled towards porta hepatis



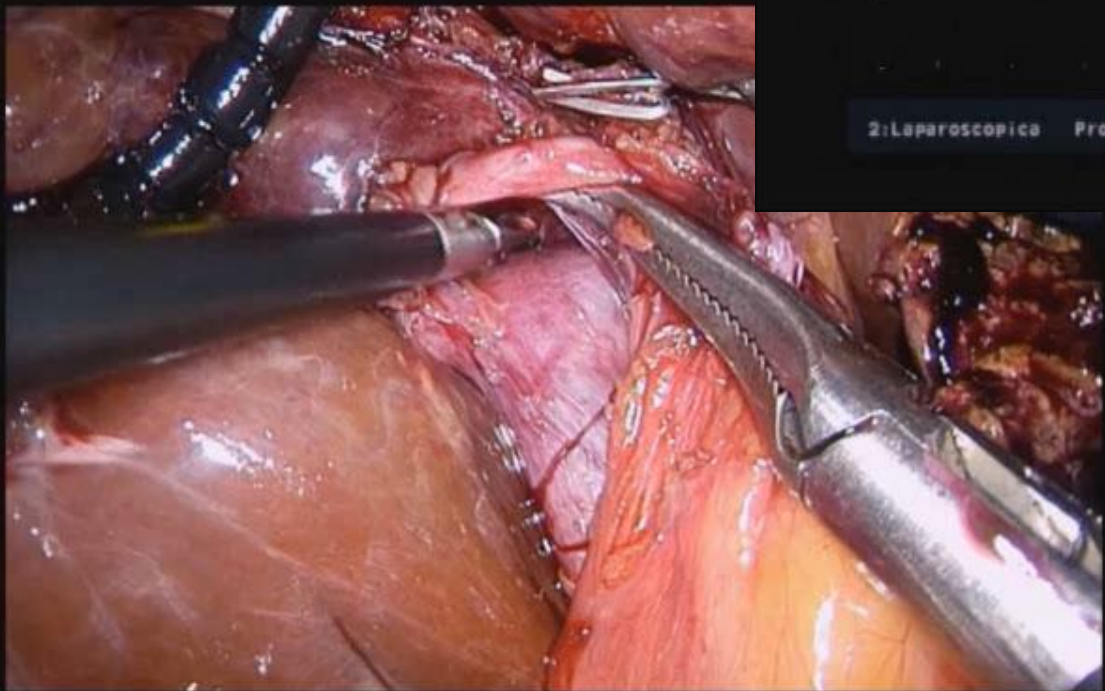
OSP. SAN RAFFAELE-BLOCCO OPERATORIO 27-05-2009 8815
 9:11:45 7.5MHz

MI: 1.8
 FR: 21
 G: 41%
 Pers2

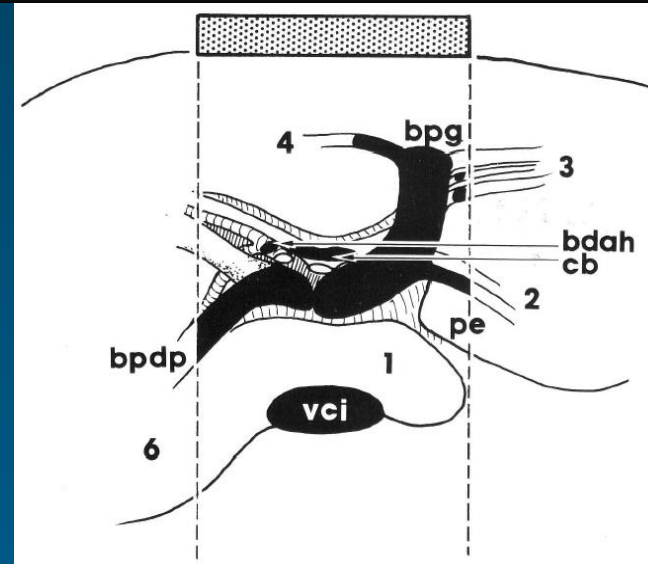


Porta Hepat

Transverse position of the

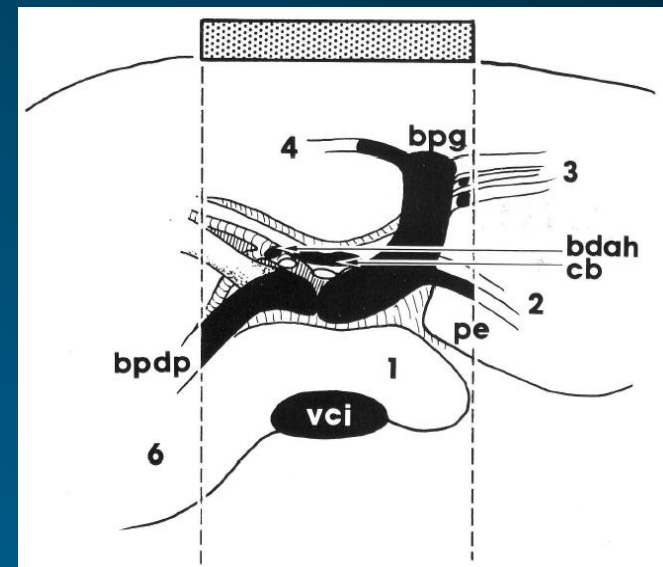
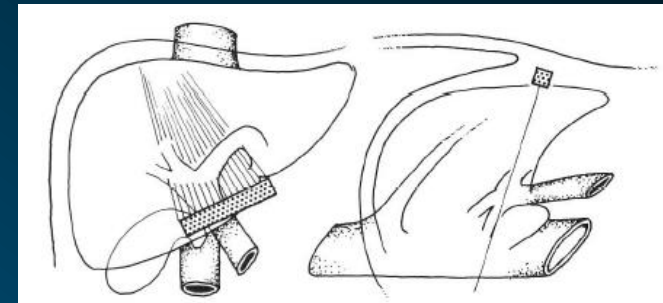


Portal vein ligation



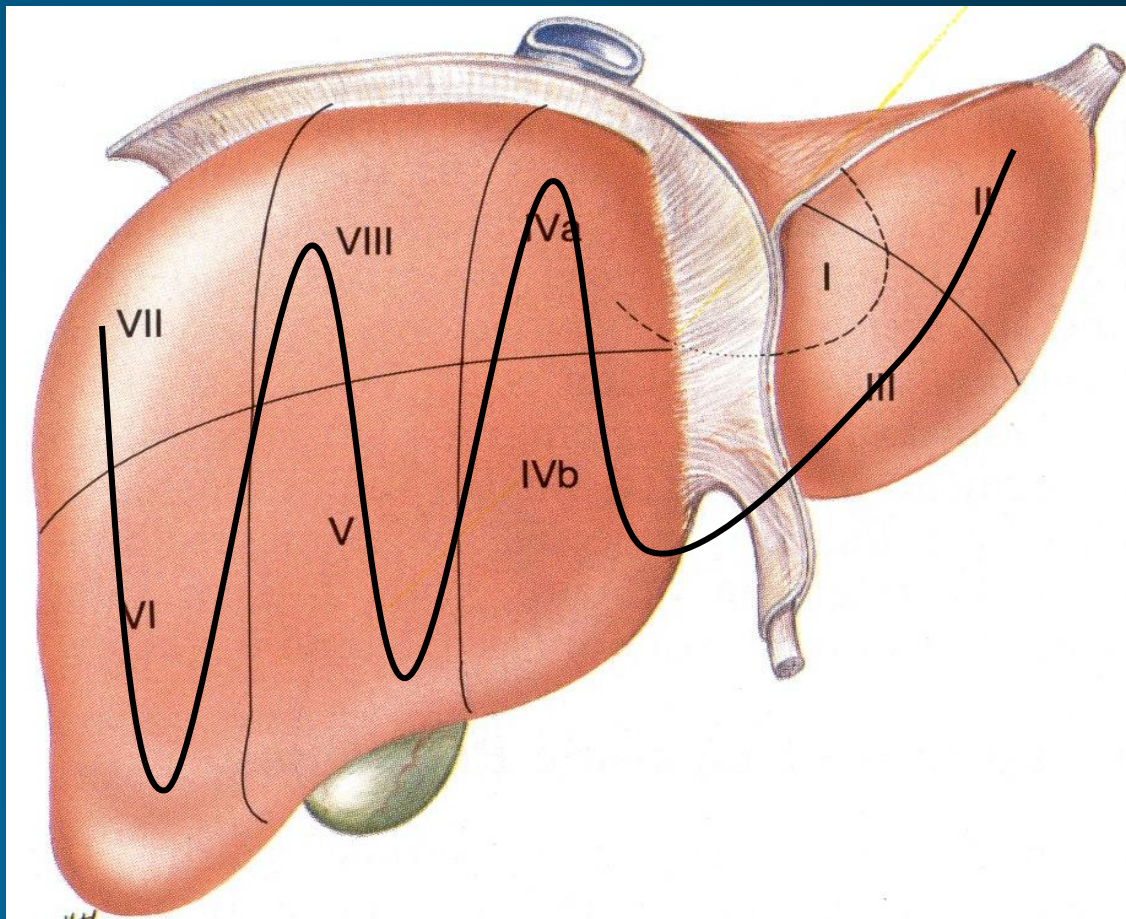
Porta Hepatis – Biliary confluence anatomy

Transverse position of the probe angled towards porta hepatis



IOUS – Resection guidance

Examination technique



Kruskal J B, Kane R A

*Intraoperative US of the Liver:
Techniques and Clinical
Applications*

RadioGraphics 2006; 26: 1067-
1084

Intraoperative US

Technical aspects

◆ Equipment

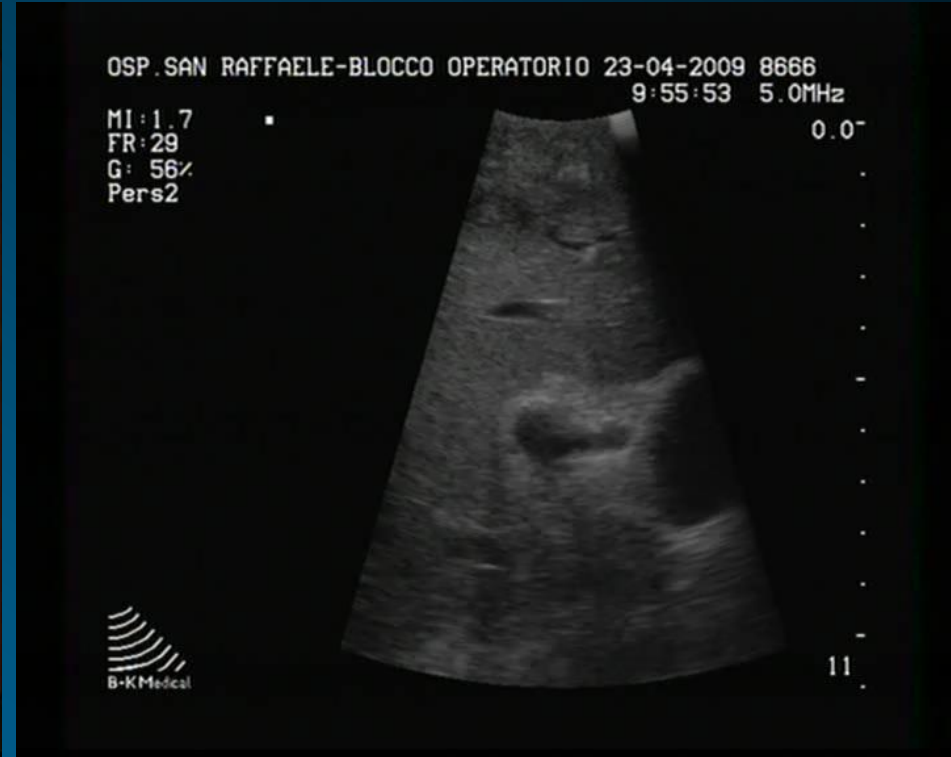
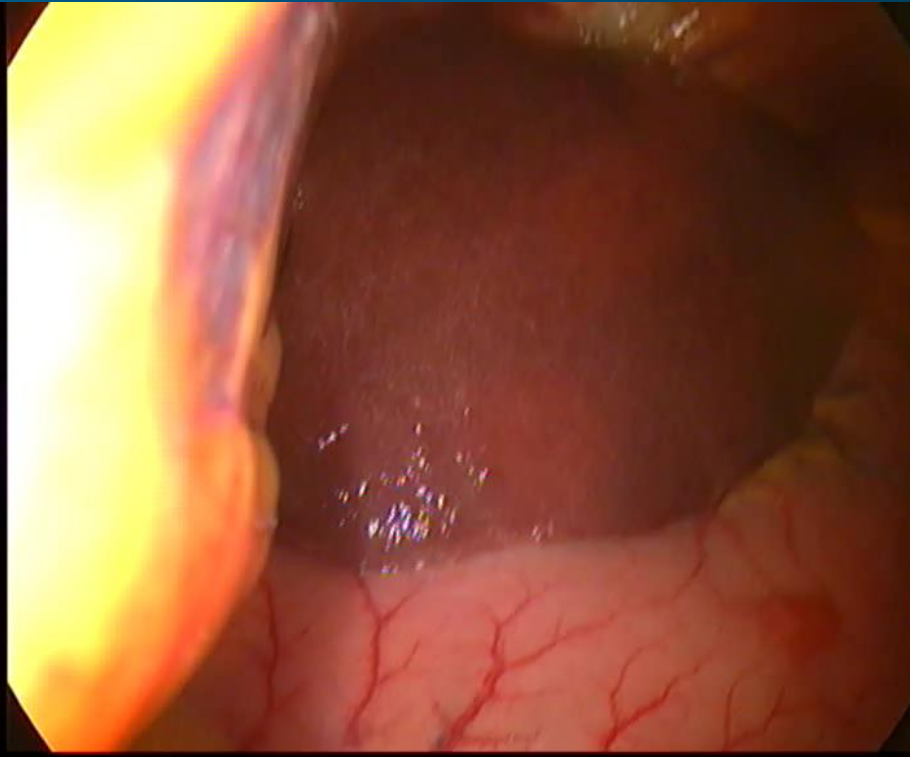
◆ Laparoscopic probe

- ✓ Low-temperature hydrogen peroxid gas plasma sterilization (*Sterrad*)
- ✓ Flexible probe in one or two axes
- ✓ Scanning range: 7.5 - 13 MHz
- ✓ Convex scanning



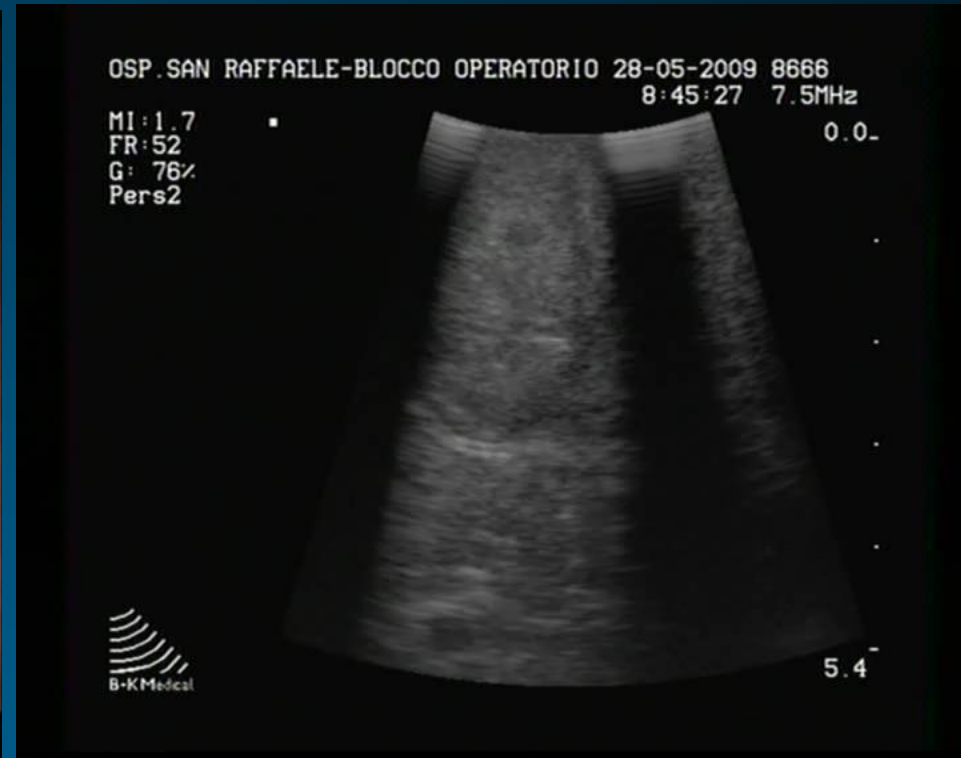
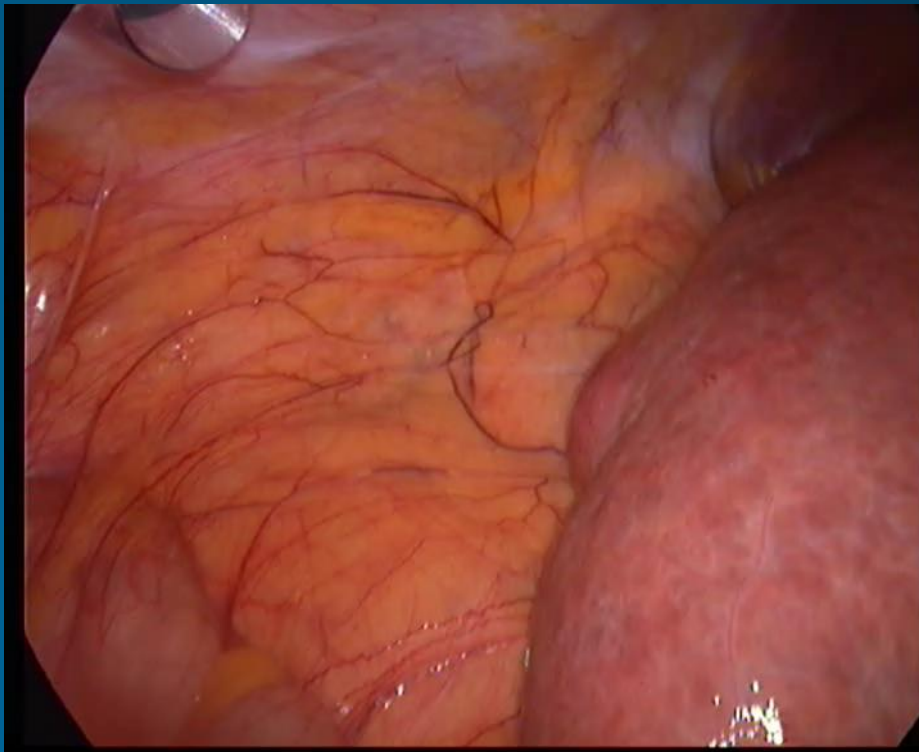
IOUS – Resection guidance

Intraoperative stadiation of disease



IOUS – Resection guidance

Radical laparoscopic resection



IOUS – Radio-frequency ablation

