

LUS: Laparoscopic Ultrasound

Dr. Bjørn Skjoldbye
Herlev Hospital
Copenhagen University

Training Course for Advanced Oncologic Laparoscopy
St. Petersburg - February 14, 2006

Equipment



- Laparoscopy
- LUS (B&K 8666, multidirectional flexible tip)
- Abdominal US
- Biopsies
- RF-treatment

LUS with flexible tip



LUS Transducer 10 mm Port



Equipment

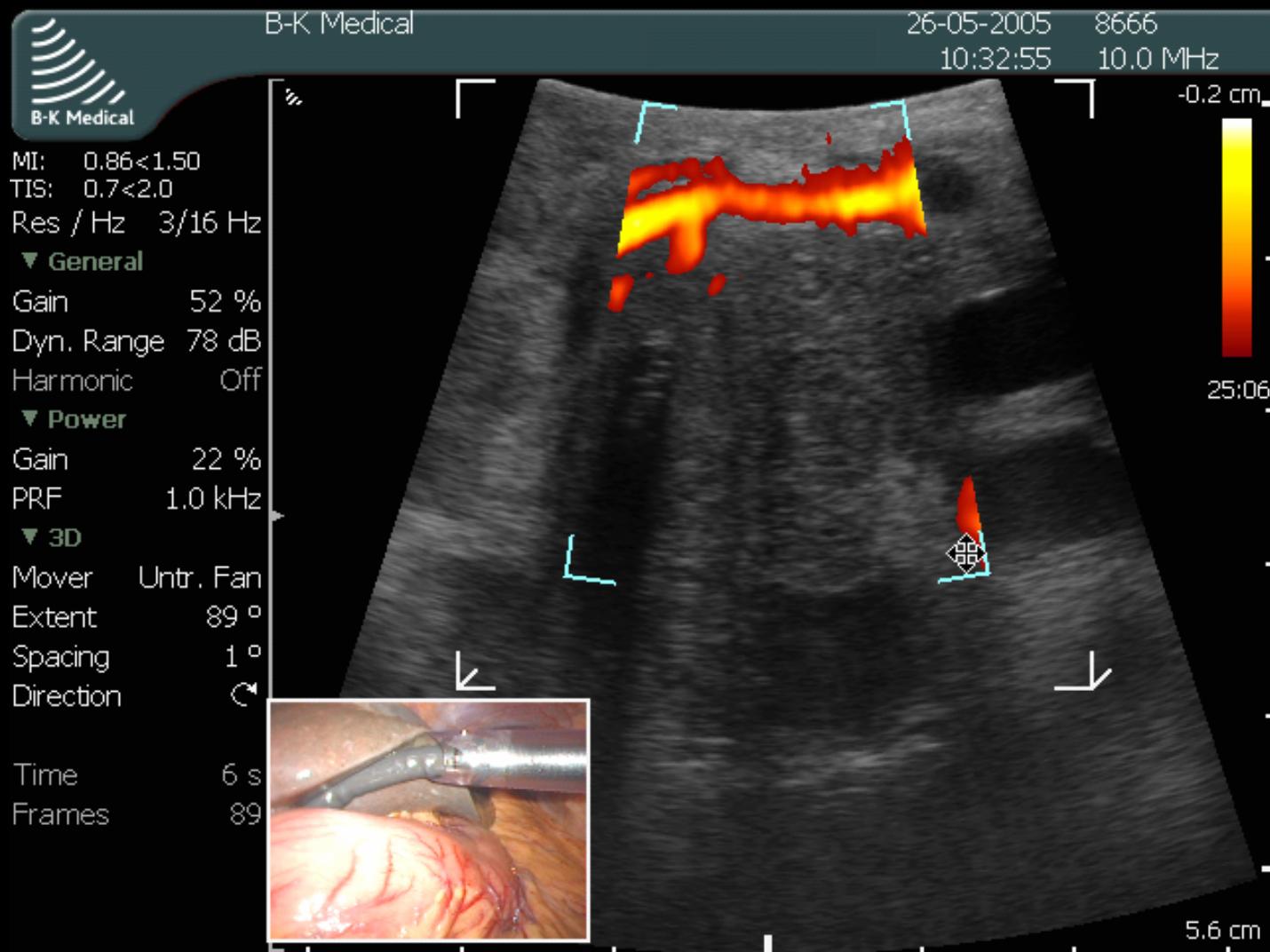
Surgical US-Scanner



ProFocus and LUS

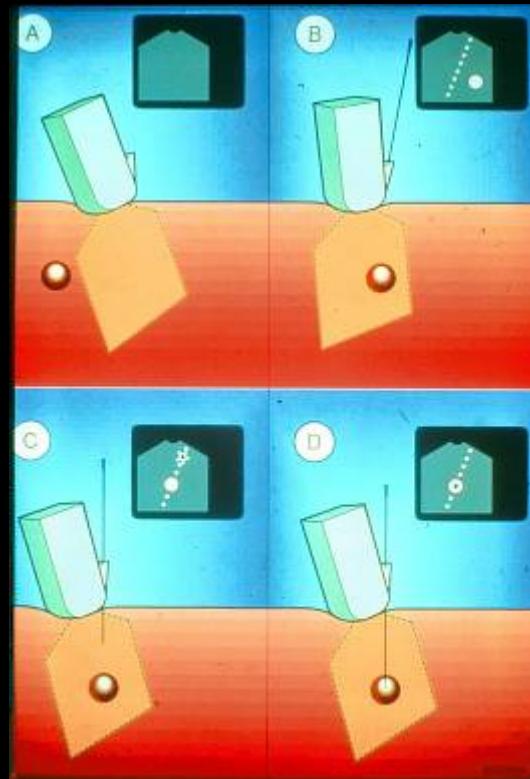


PiP: Picture in Picture



Principles of US-guided biopsy

- 2D-image
- Target in image
- Target on line
- Insertion of the biopsy needle



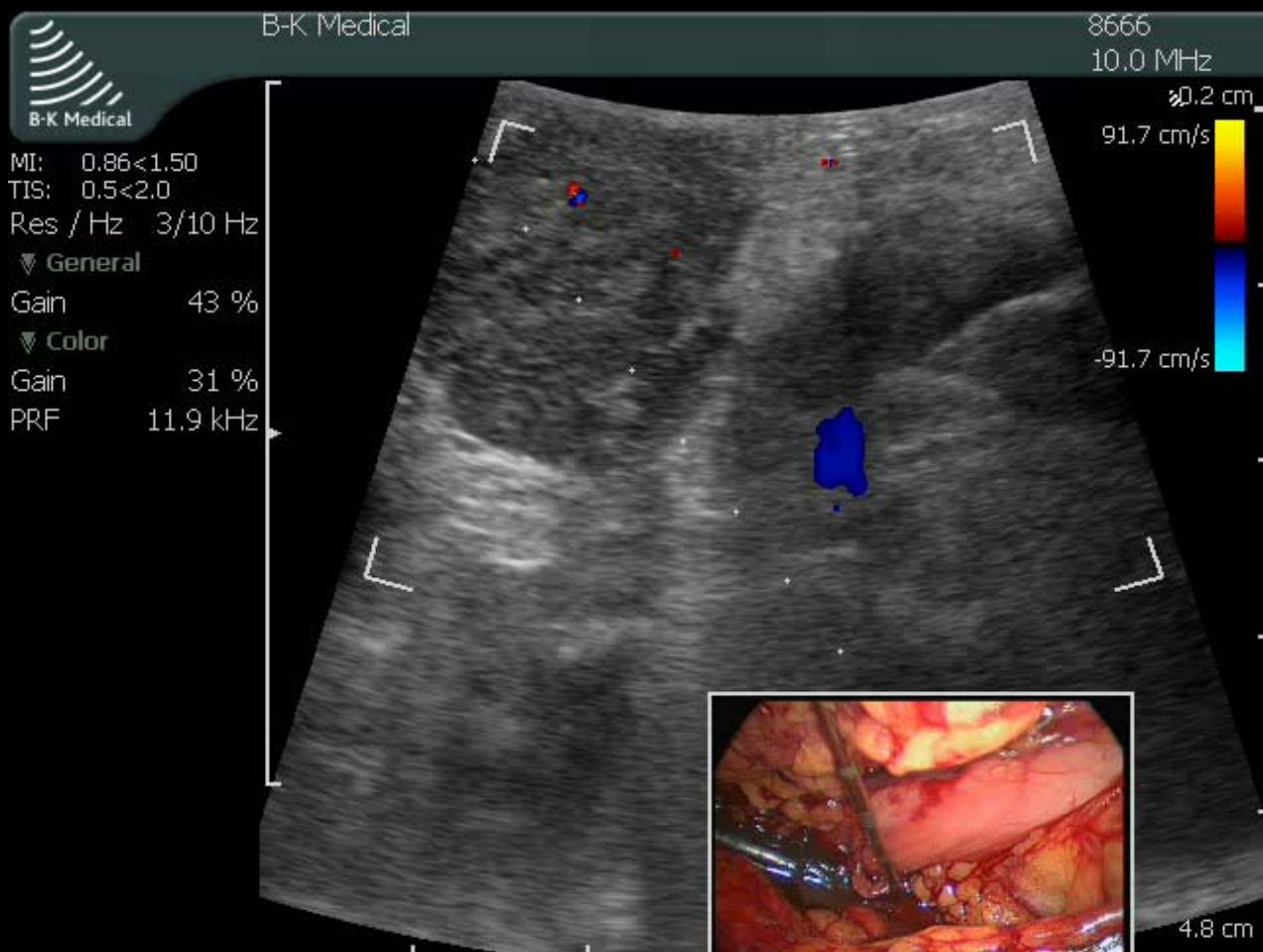
LUS-guided intervention



LUS-guided TRU-cut Biopsy



LUS-guided biopsy



Percutaneous Biopsy c.pancreatis

Map 3
150dB/C3
Persist Med
Fr Rate Med
2D Opt:Res



LUS Guided Biopsy

Needle Guide



UNIVERSITY HOSPITAL HERLEV

MI: 1.9
FR: 34
G: 63%
Prs: 2

09-08-2000 8659

□ 10:36:24 5.0MHz

0.0



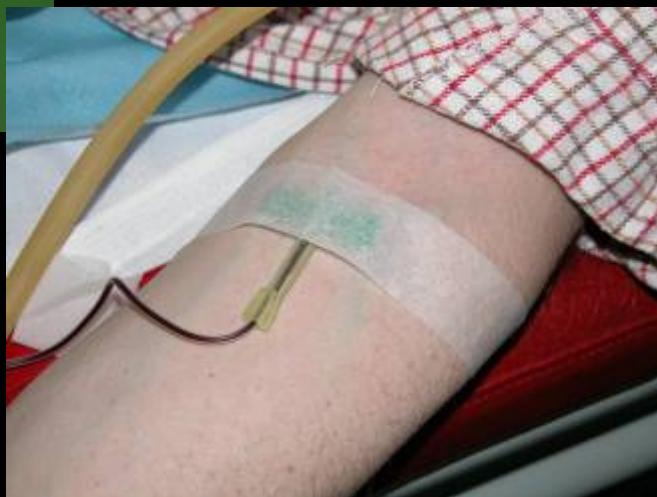
6.8

Freehand Technique

US-contrast

- Adding an edge to LUS
- Requirements:
 - I.v access
 - Equipment capable of Contrast Harmonic
 - Contrast Media for infusion

SonoVue



T=0



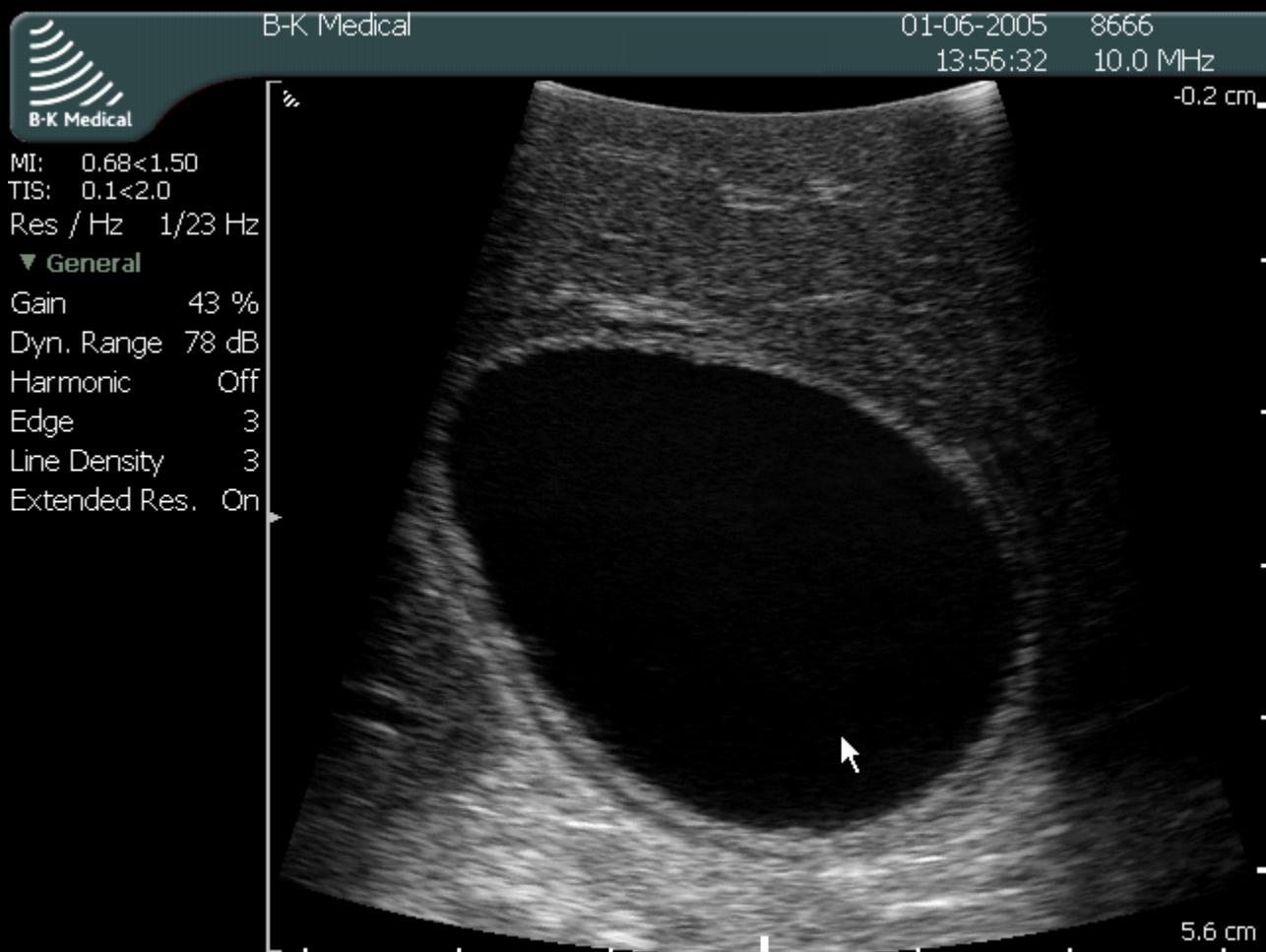
2.4 ml bolus i.v.



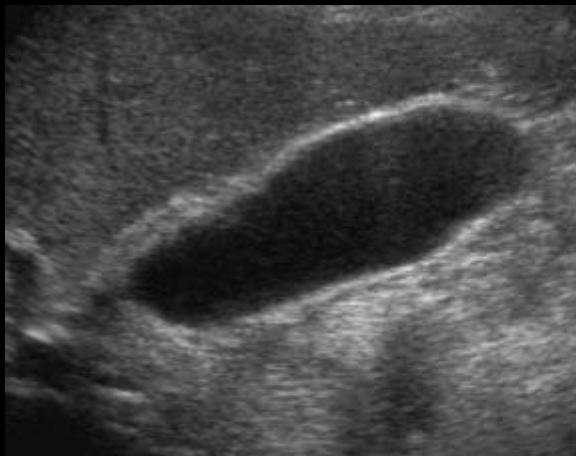
LUS: Hepato-biliary applications

- Tumors – Classification - Resectability
- Cystic-Solid Differentiation
- Fluid Collections – Abscess – Fistulas
- Biliary Obstruction
- Biliary Stones
- Parenchymal Evaluation

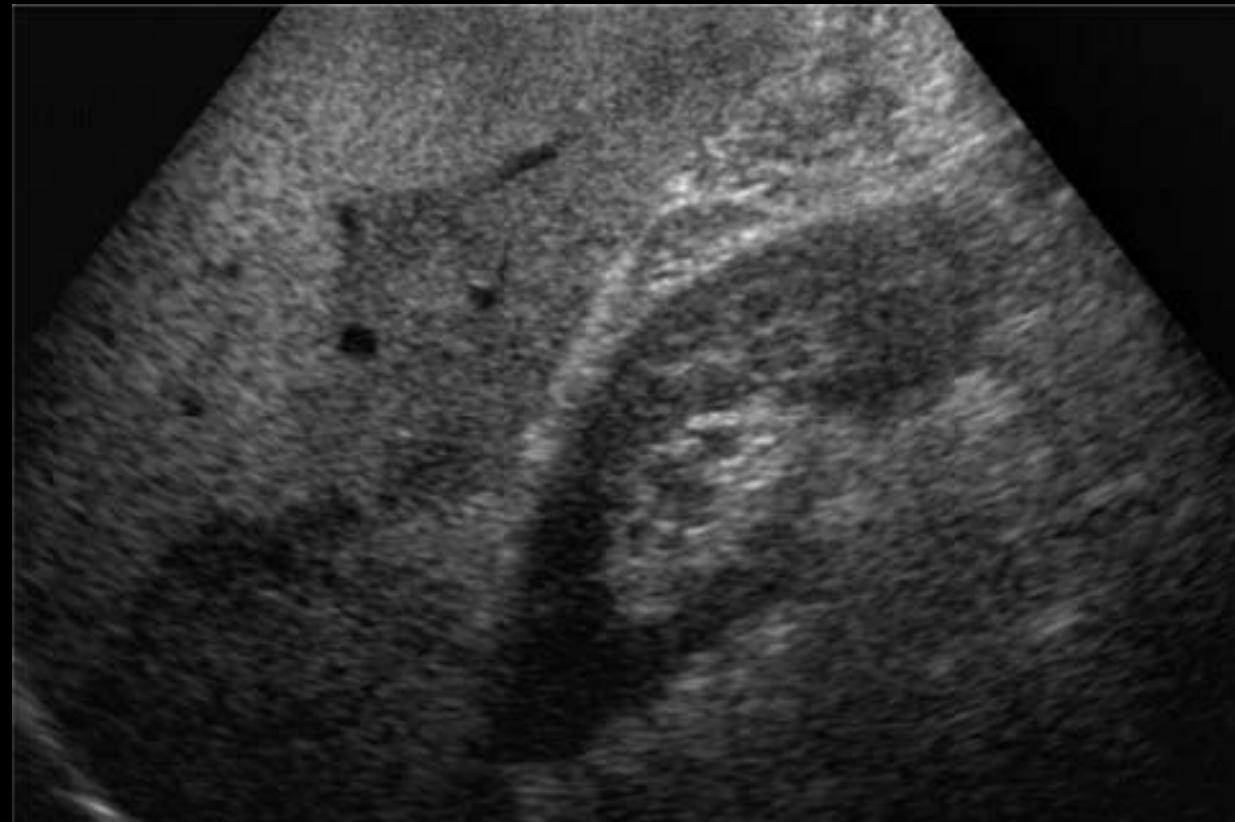
Gall-Bladder



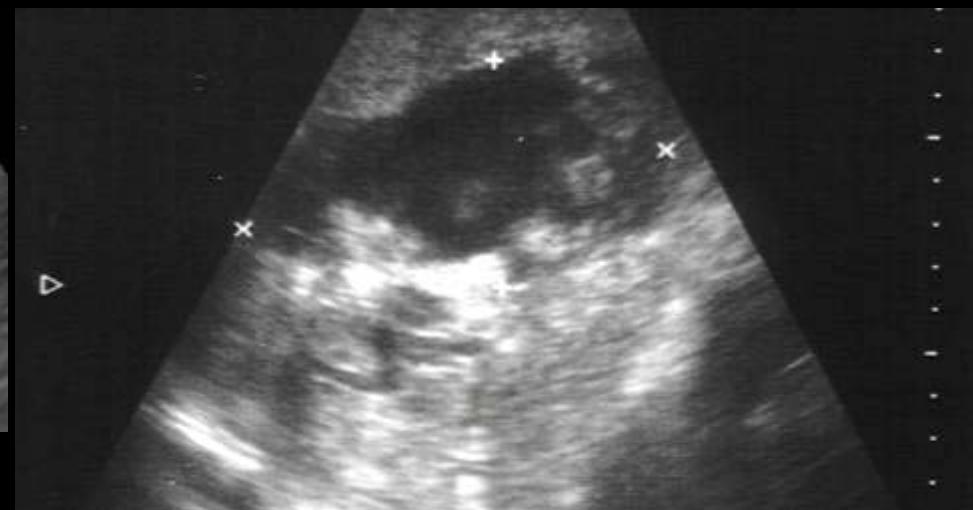
Cholecystitis & Gall bladder with stones



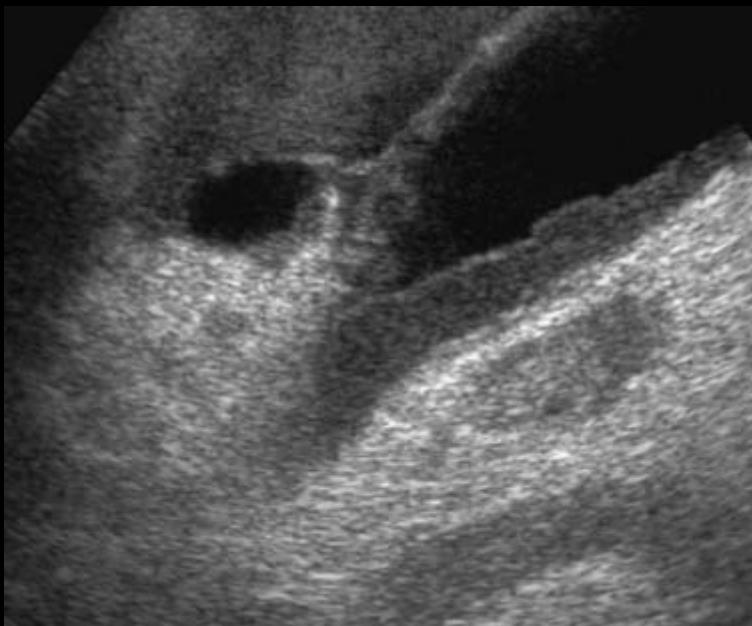
Fatty liver (bright liver) & Focal Fatty Sparring



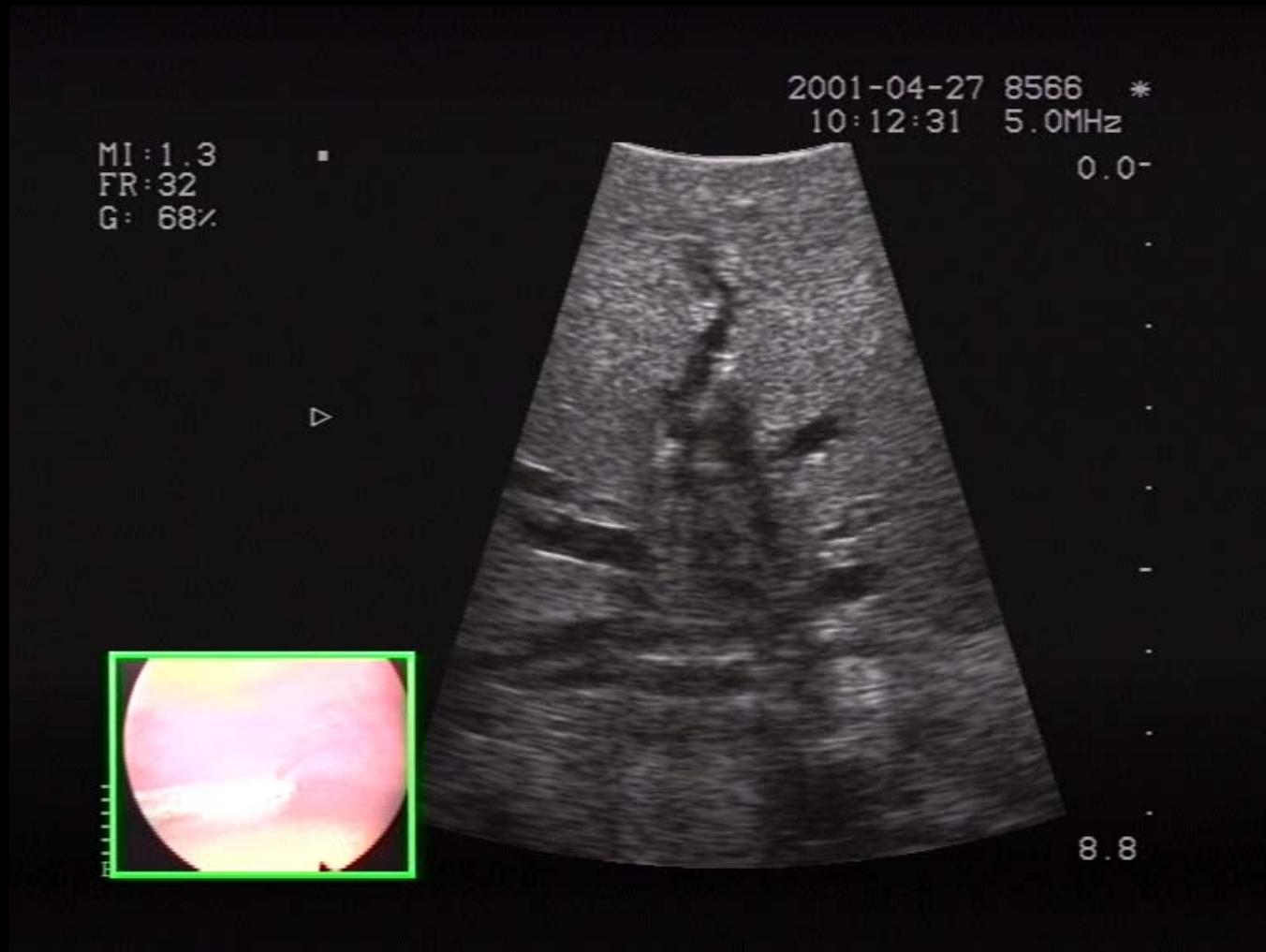
Simple cyst vs complex malignant cyst



Abscess & Fistula



Klatskin Tumor



Pancreatic Cancer

- 5 yr survival: 0.5% Wipples: max 25%
- Distant metastasis or carcinosis: 50% alive < 6m
- 80-90% non-resectable at time of diagnosis
- Only 40-60% resectable pre-operatively are resectable at time of operation

Pancreatic tumor and endoprotesis

MI:1.5
FR:30
G: 79%

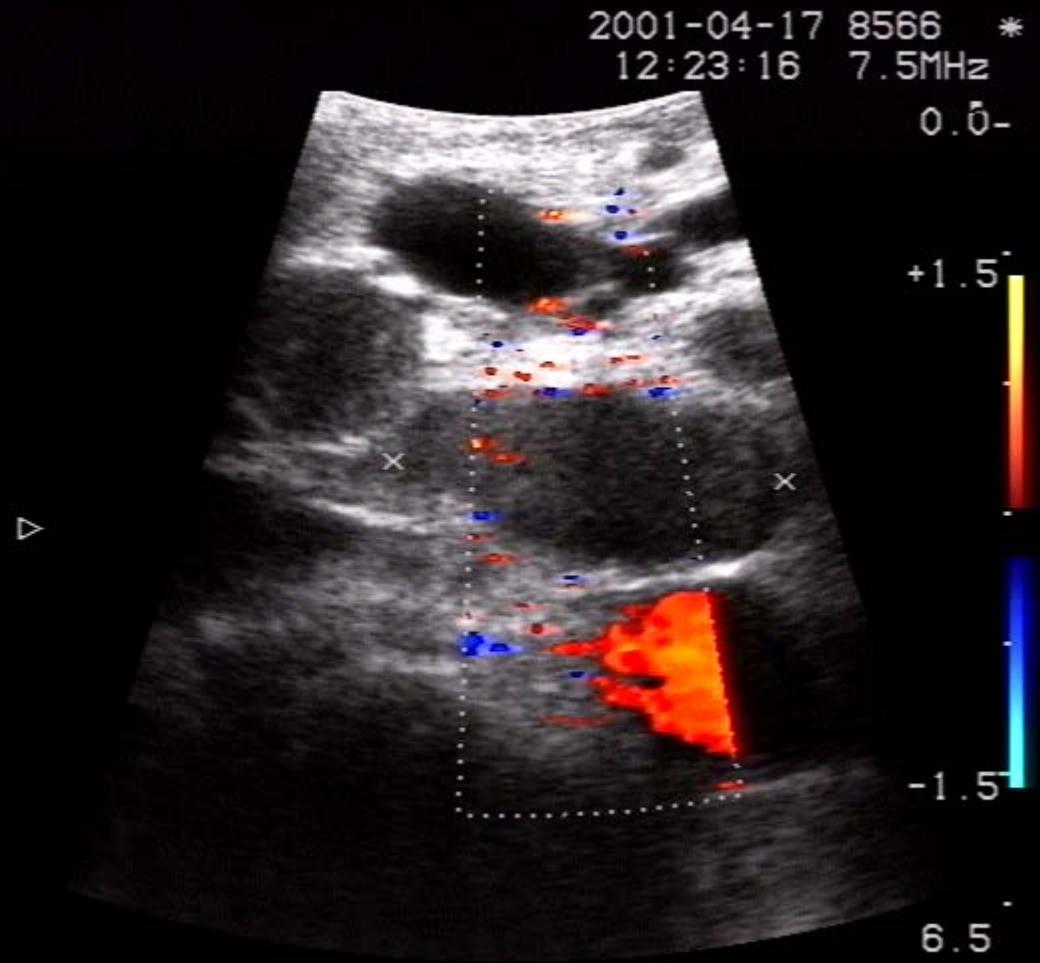
2000-04-03 8555 *
9:04:54 6.5MHz
0.0-



Lymph Adenitis & Dilated Common Bile Duct

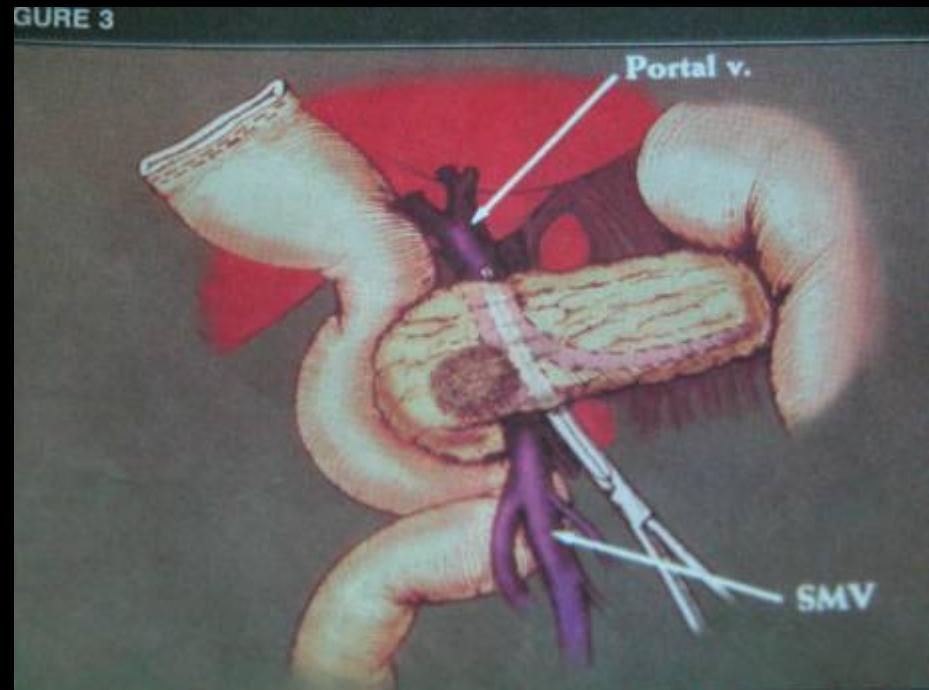
TIS:1.0<2
FR: 15
G: 65%
CG: 46%
PRF:3004
WF: 143
Res:2
Prs:4

x: 31mm

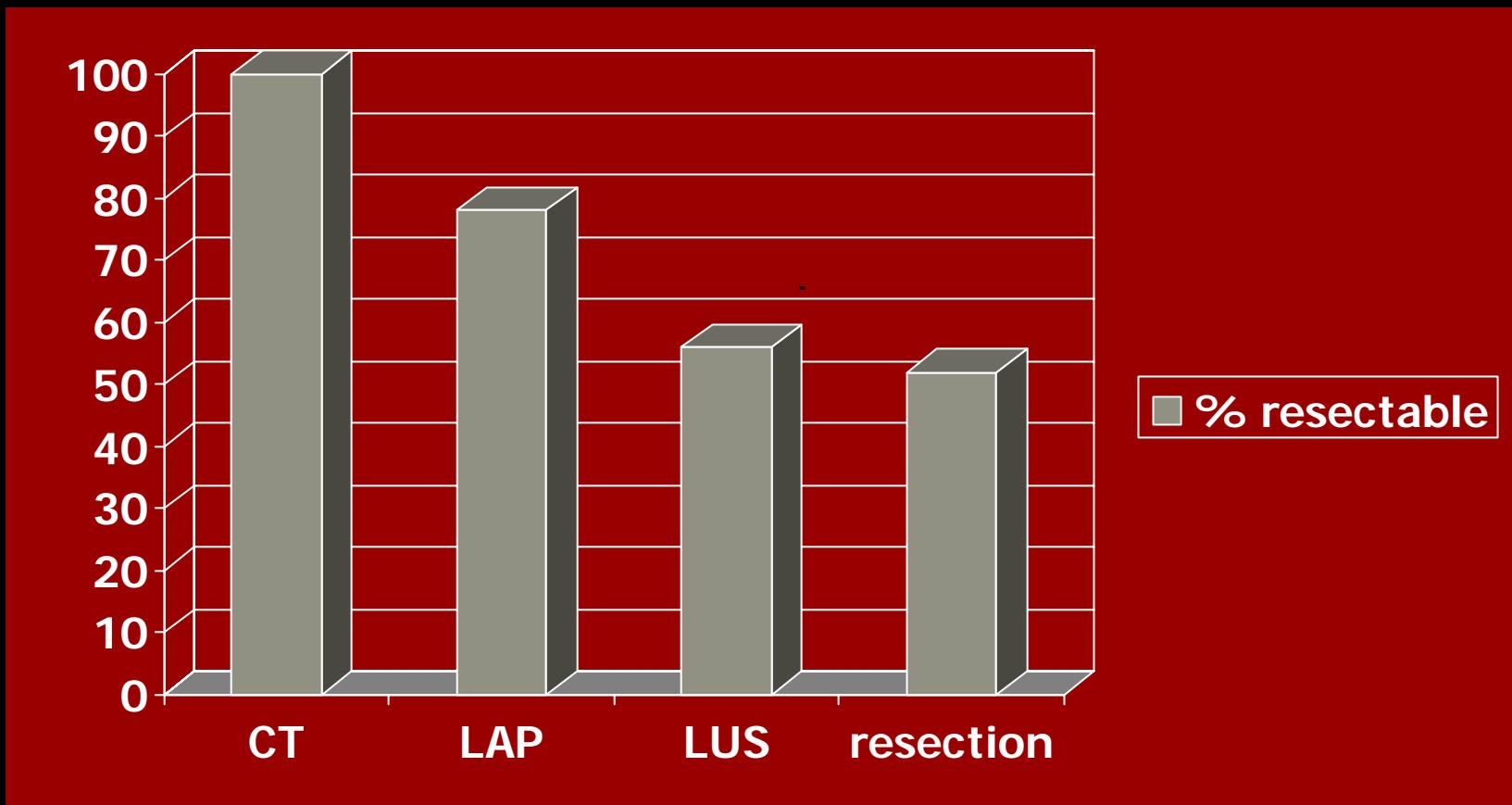


Pancreatic cancer - Surgical approach

- Wipple's operation
- Palliative surgery
- Endoprotesis
(stenting)



CT vs. LAP & LUS

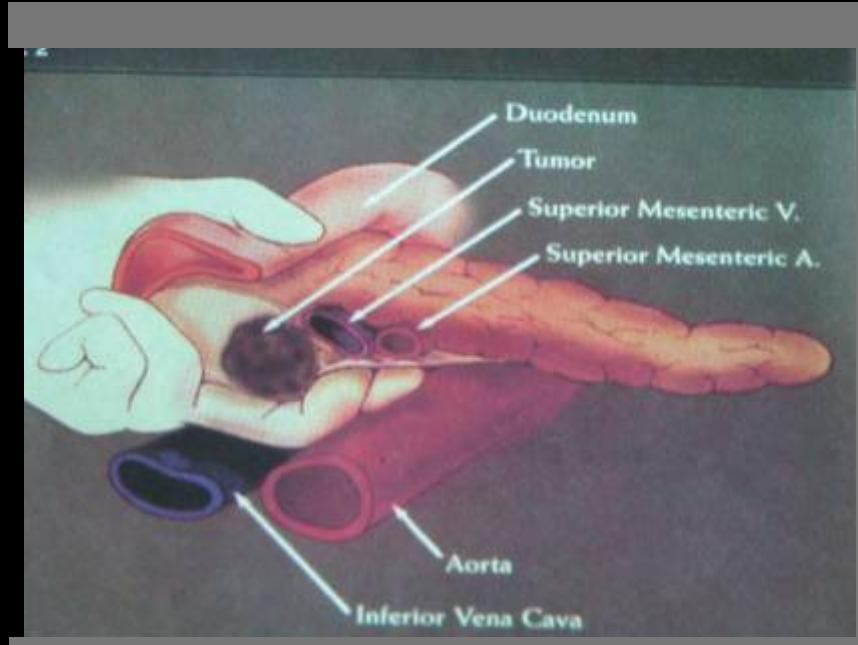


Diagnostic Sensitivity

Sens. %	Pancreatic tumor	Glandular Met.	Liver Met.	Peritoneal carcinose	Vascular Encasement
UL	50	40	60	10	0
CT	77	50	60	0	0
EUS	100	62	33	17	100
LAP LUS	88	90	100	100	100

Surgical treatment of Pancreatic Cancer

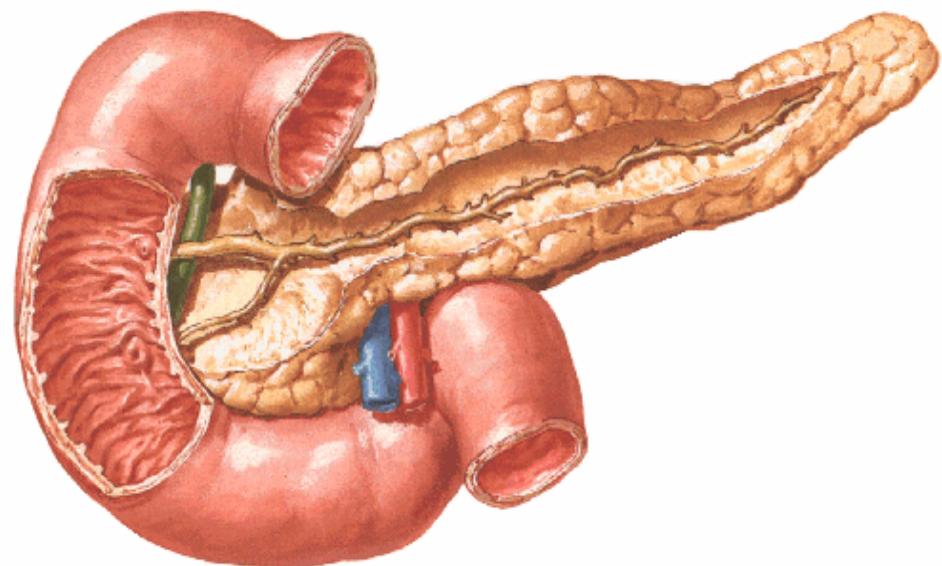
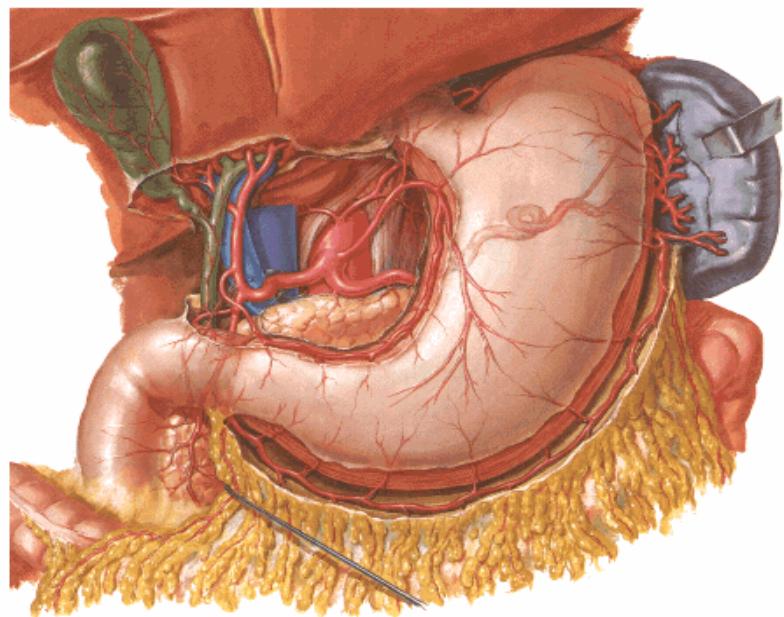
- Wipples operation is only potentially curative treatment of pancreatic cancer
- Successful outcome of Wipples operation require radical surgery
- Preoperative staging is required to avoid unnecessary surgery



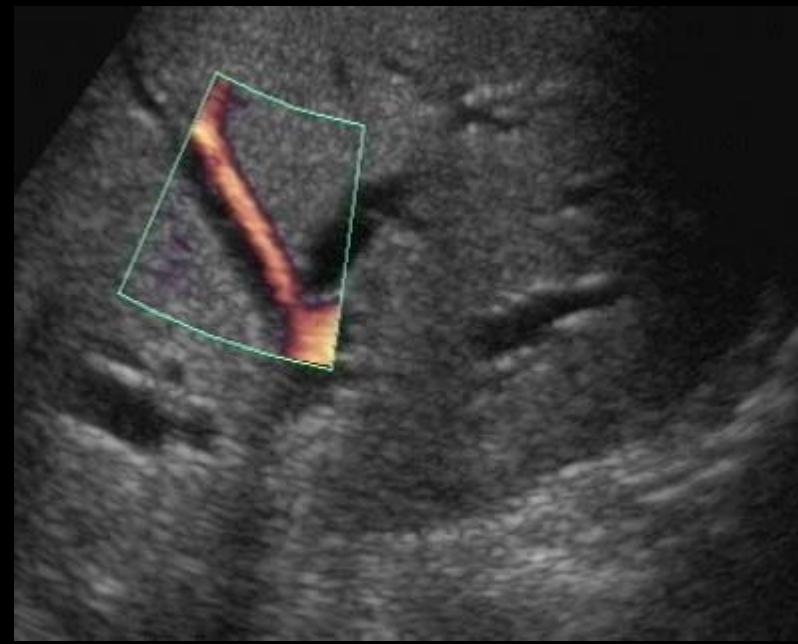
Criteria for non-resectability

- Liver metastases
- Carcinosis
- Lymph node metastases
- Vascular encasement
- Invasion of neighbouring organs

Anatomy



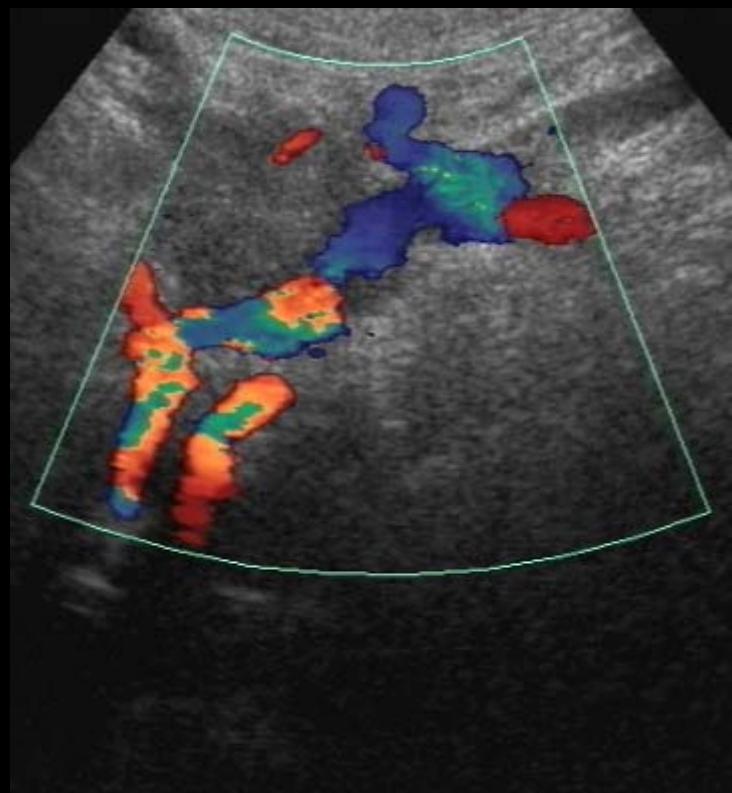
Intra-hepatic bileduct dilatation



US-Signs to be noted



Invasive growth in sup. mes. Vein



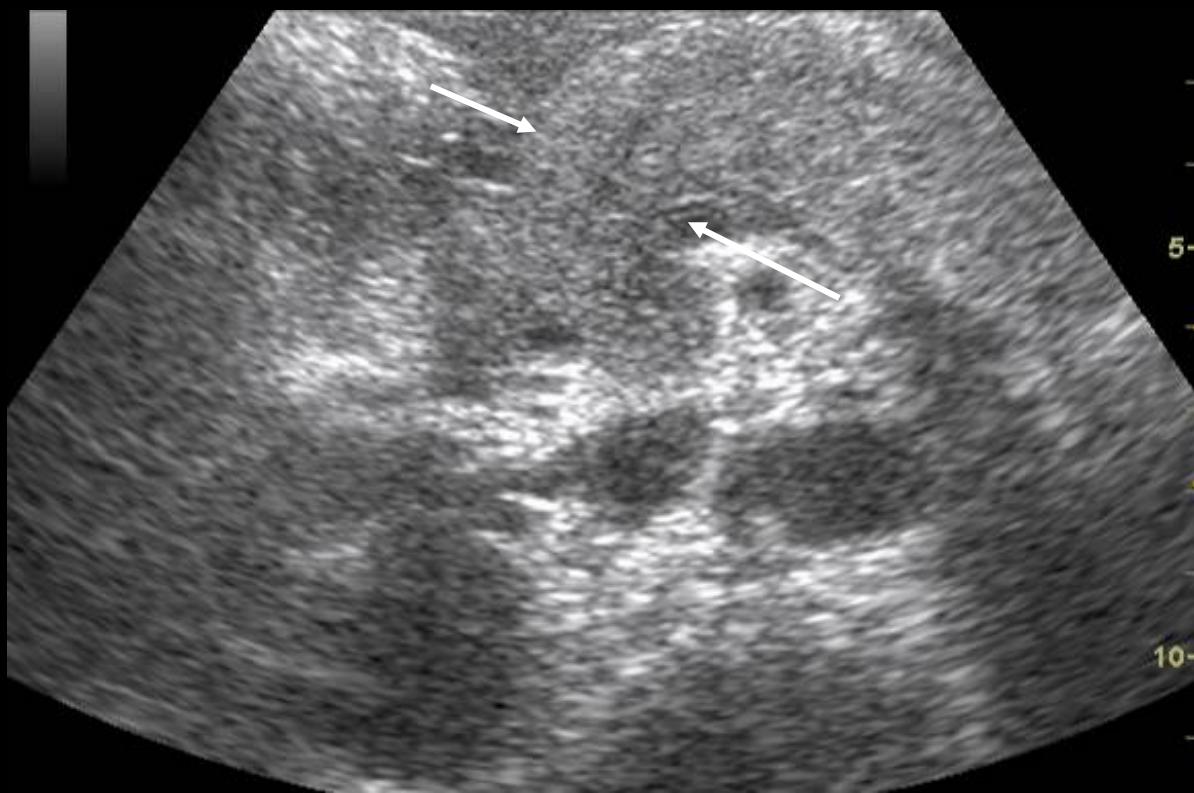
Non-resectable c.pancreatis



Lymph Node Metastasis

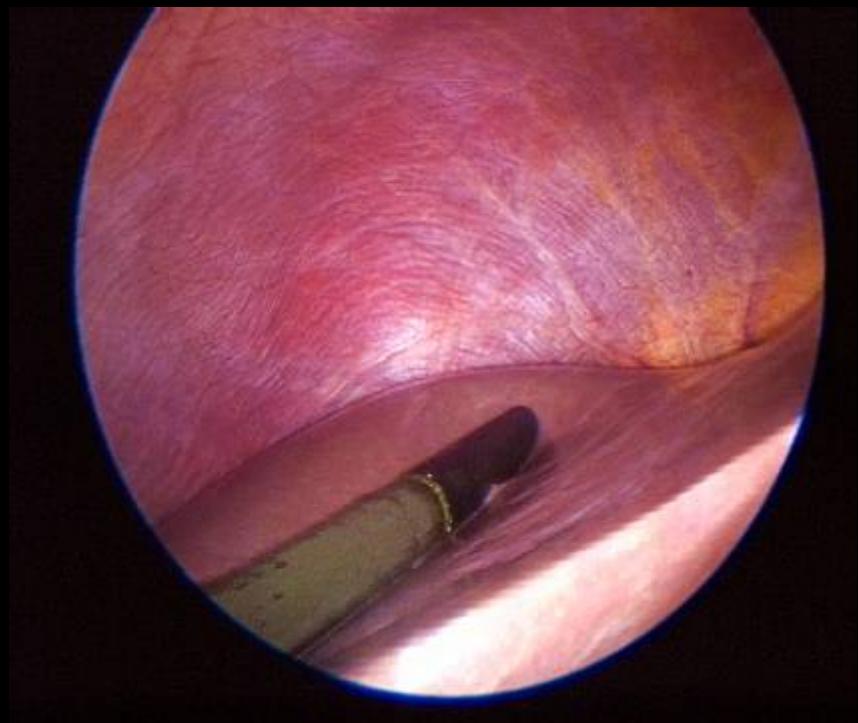


Enlarged pancreatic gland

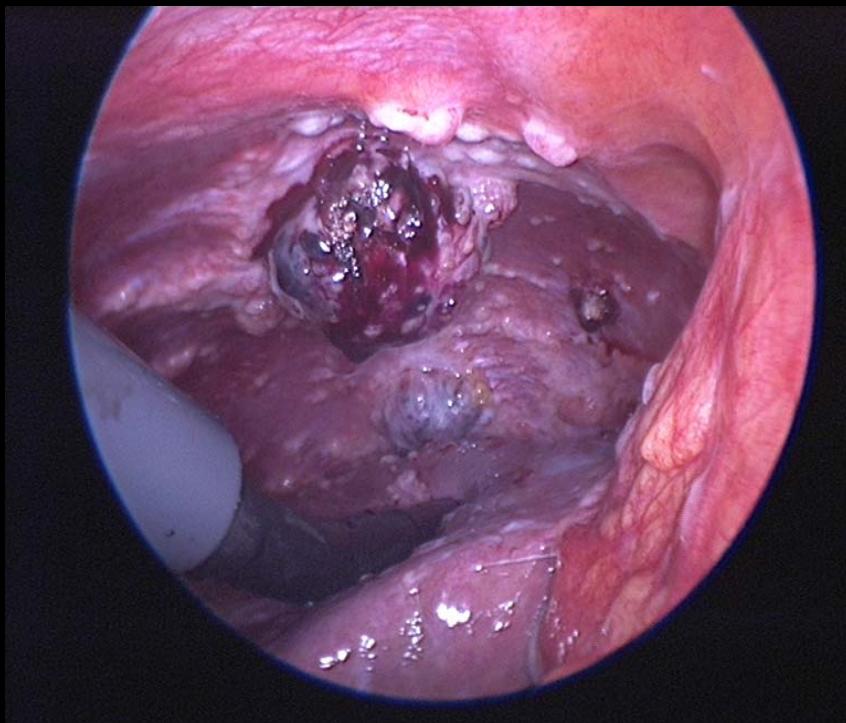


Method

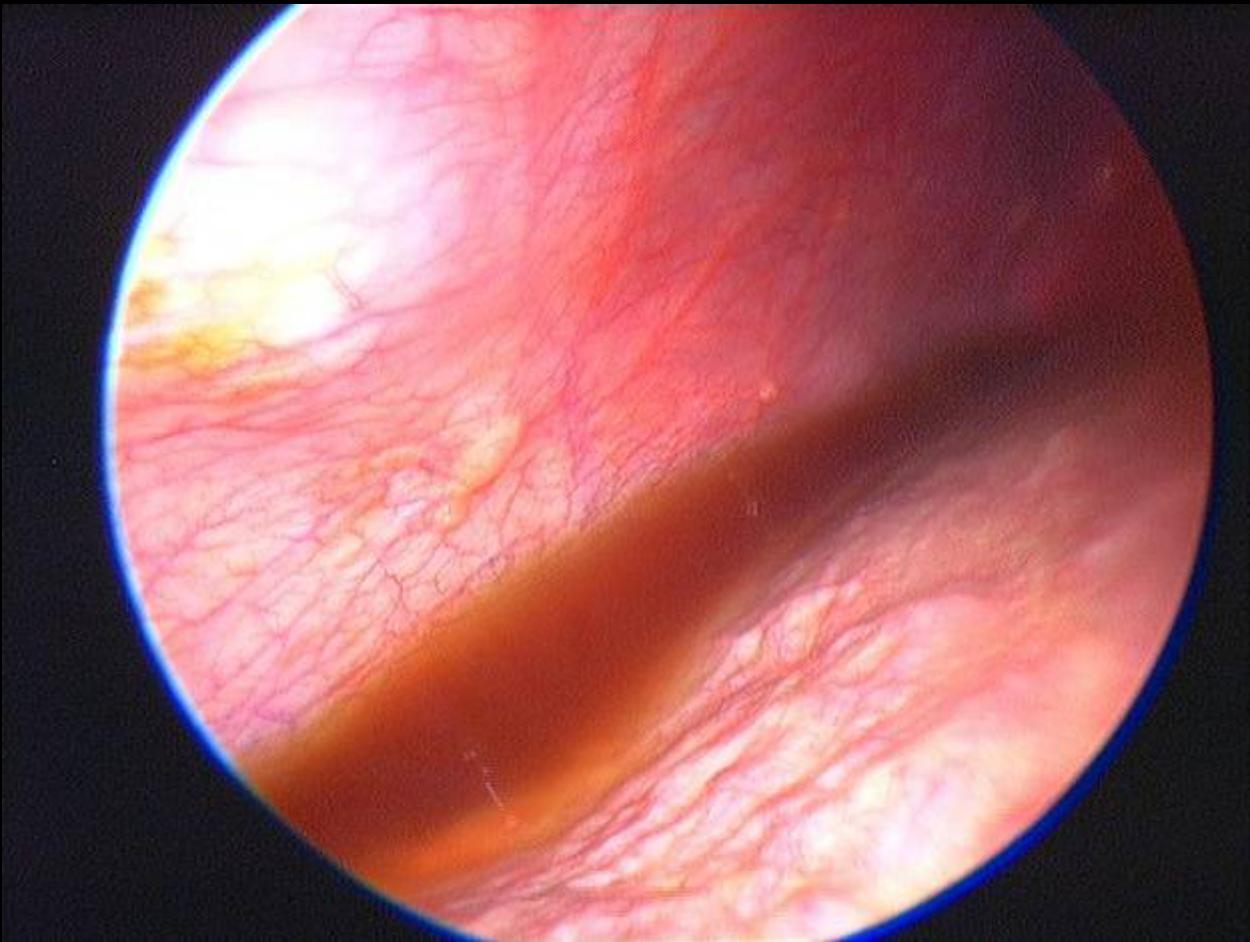
Combined Laparoscopy & LUS



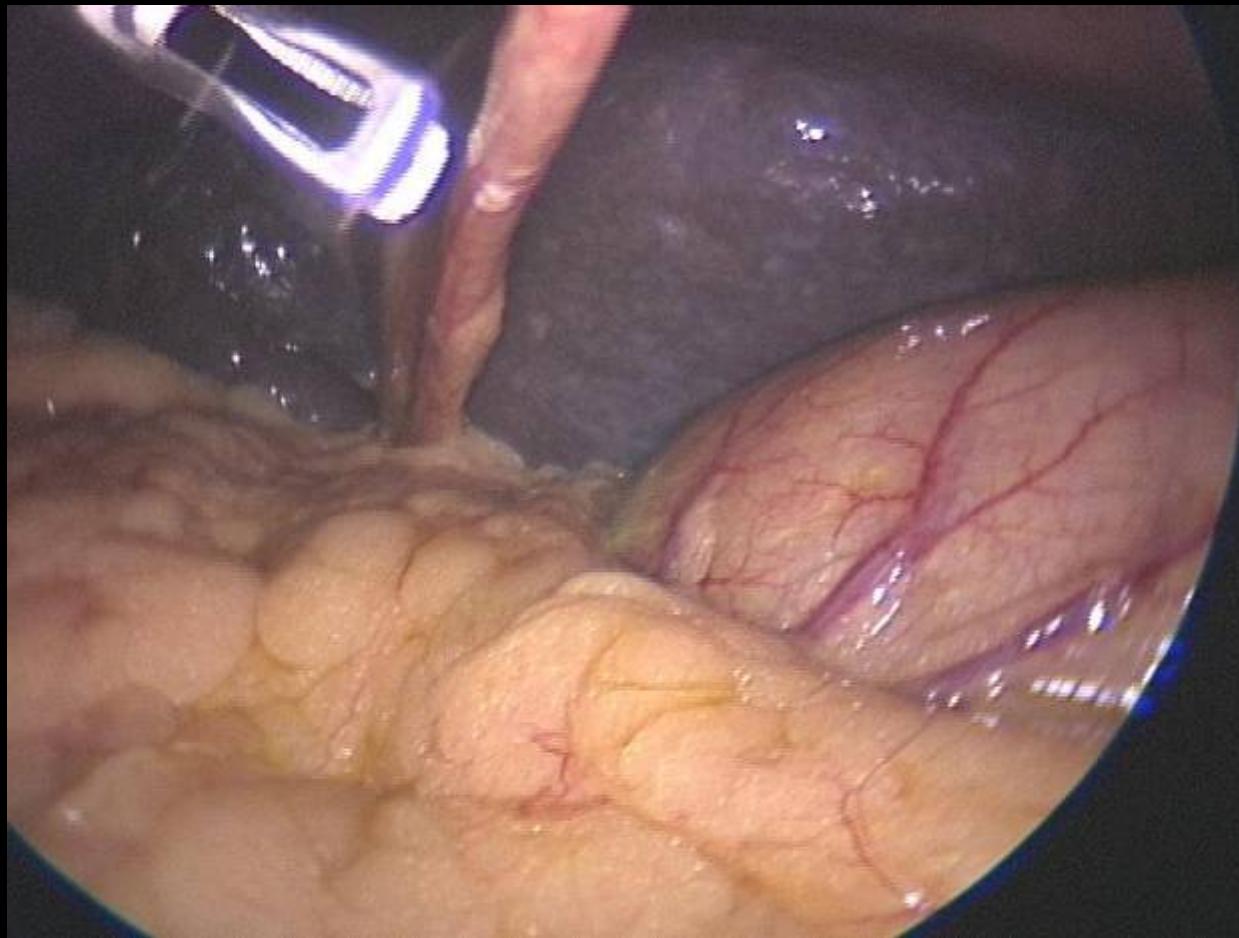
Carcinosis



Ascites



Carcinosis - Biopsy



Staging pancreatic cancer with Laparoscopy and Laparoscopic Ultrasound



KAS HERLEV KIR. AFD.

M1:1.5
FR:45
G: 67x
Pre:2

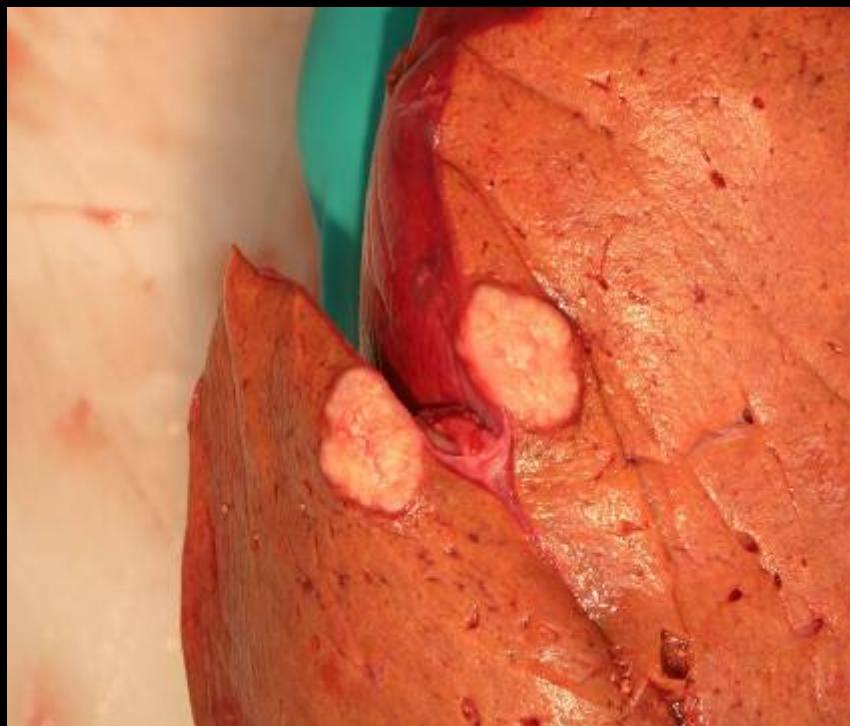
25-01-2005 06666 *
9:03:24 10.0MHz

0.0-

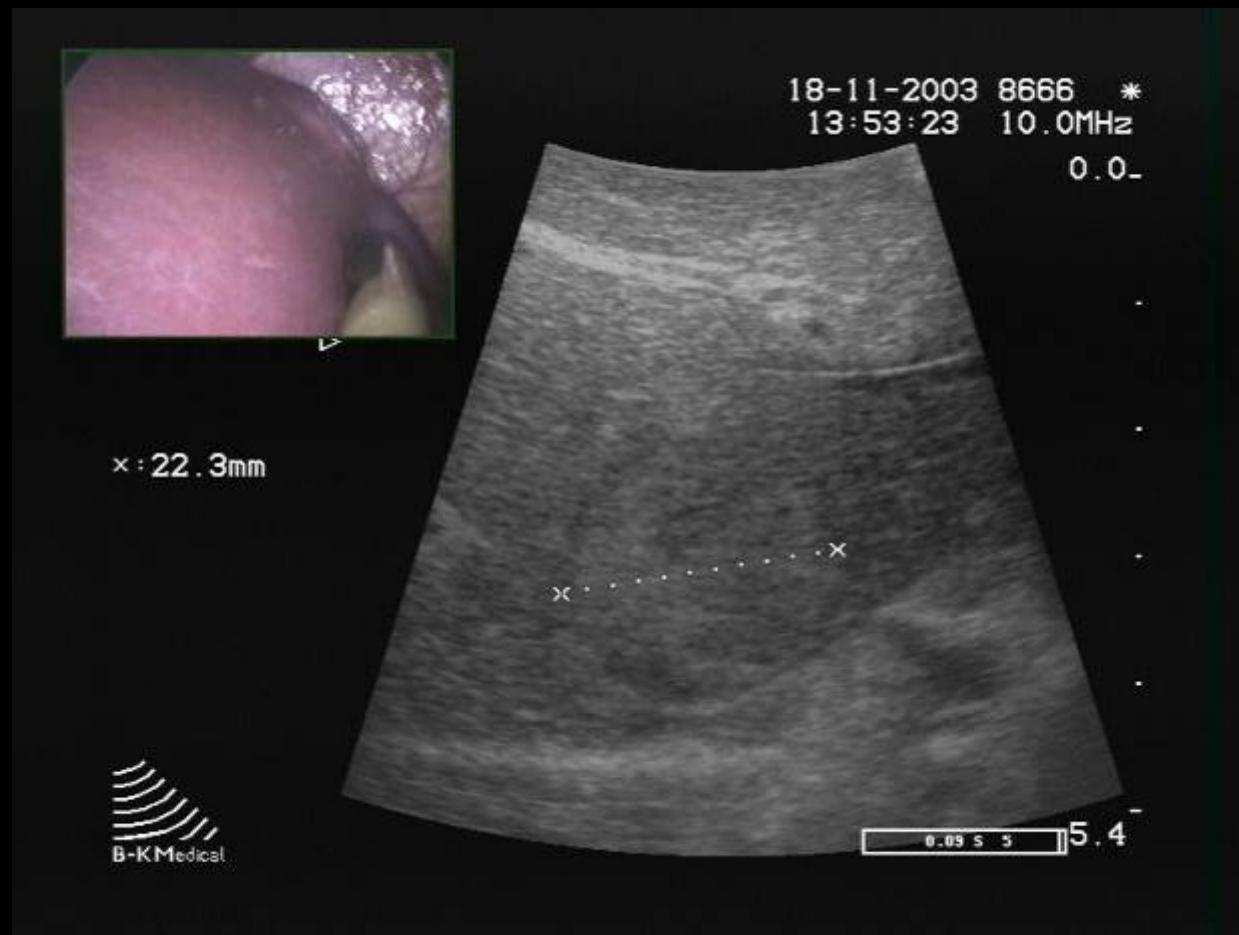


6.5

Liver metastasis



Liver metastasis



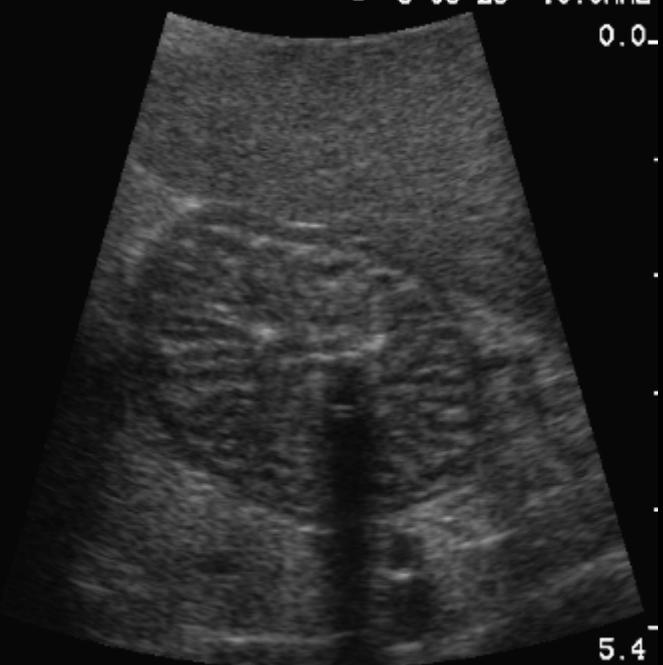
Gastric tube

KAS HERLEV KIR. AFD.

MI:1.2
FR:52
G: 51%
Prs:2

09-02-2005 8666 *
□ 9:06:26 10.0MHz

0.0-



B-K Medical

5.4

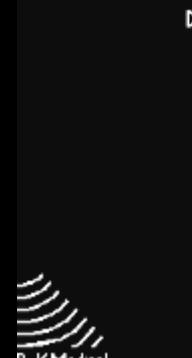
Endoprotesis

KAS HERLEV KIR. AFD.

MI:1.3
FR:35
G: 67%
Prs:2

25-01-2005 8666 *
□ 9:01:24 10.0MHz

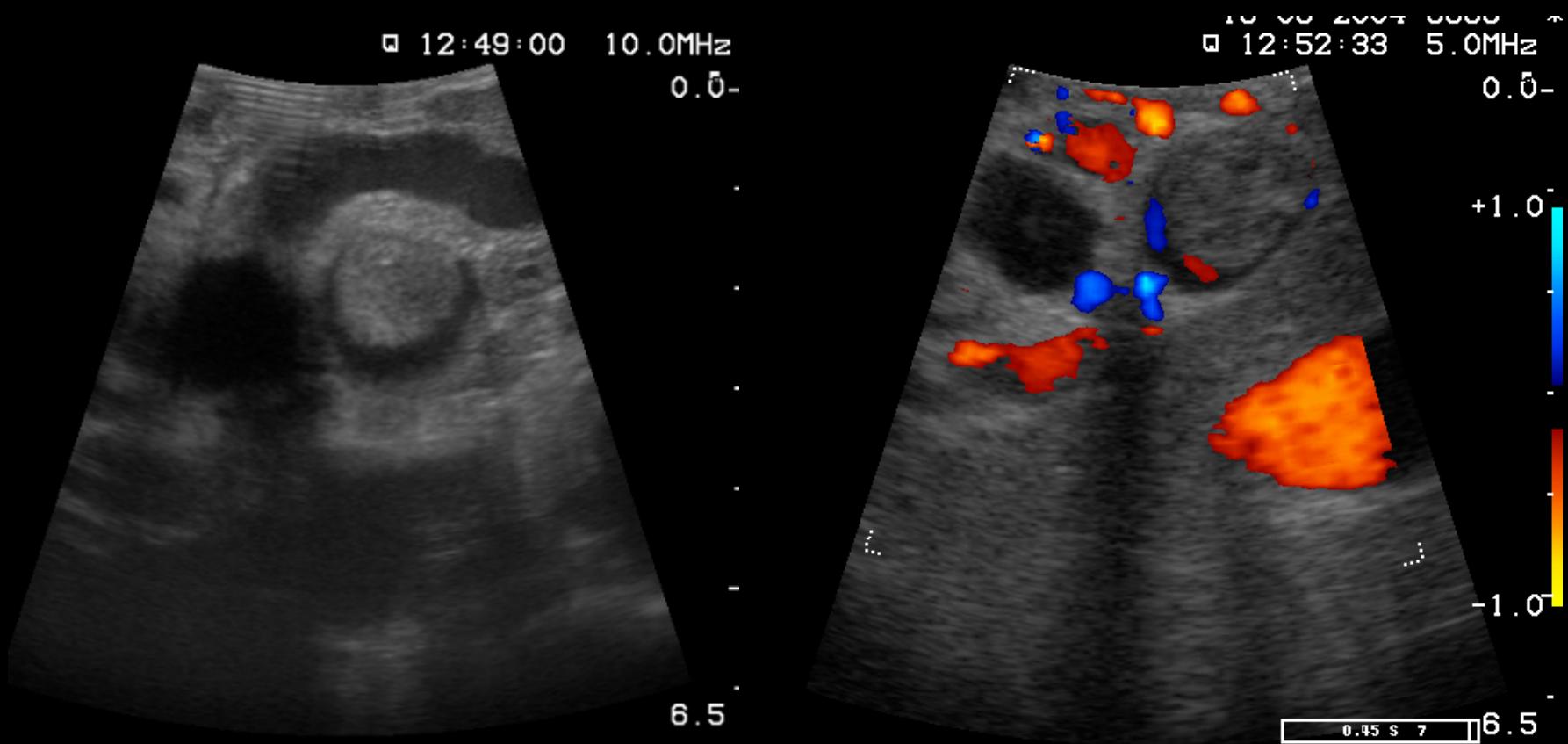
0.0-



B-K Medical

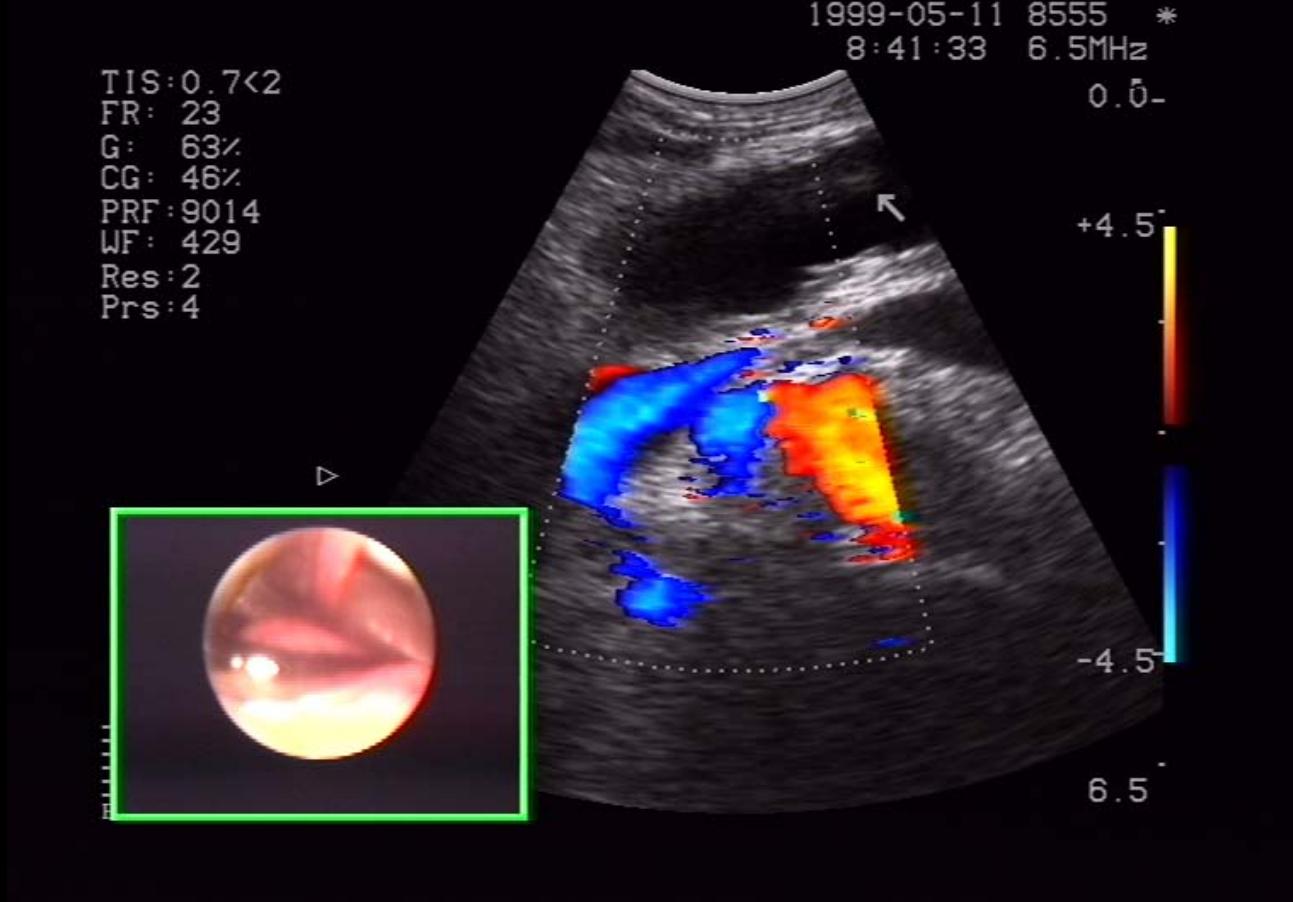
8.8

Double duct dilatation Portal Thrombosis and collateral flow



Doppler Imaging

Dilated pancreatic duct



Sub-centimeter Liver Metastases

KAS HERLEV KIR. AFD.

MI:1.1
FR:45
G: 56%
Prs:2



11-02-2005 8666 *
□ 15:19:01 5.0MHz

0.0-



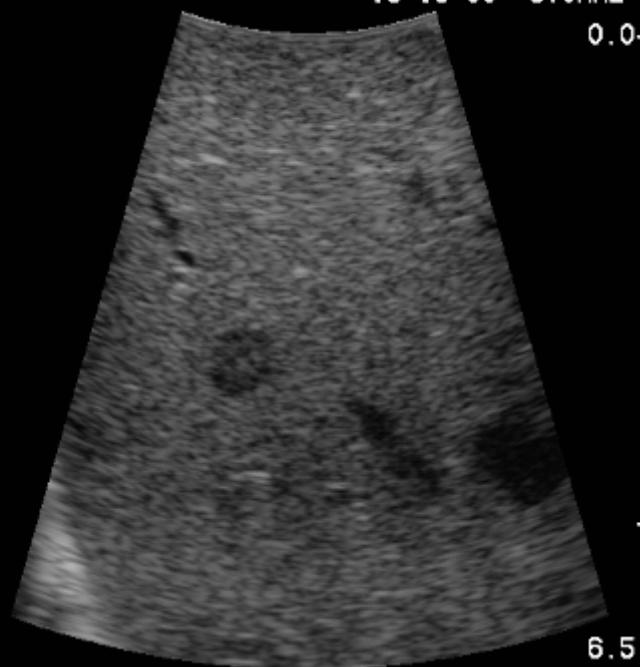
KAS HERLEV KIR. AFD.

MI:1.1
FR:45
G: 56%
Prs:2



11-02-2005 8666 *
□ 15:18:00 5.0MHz

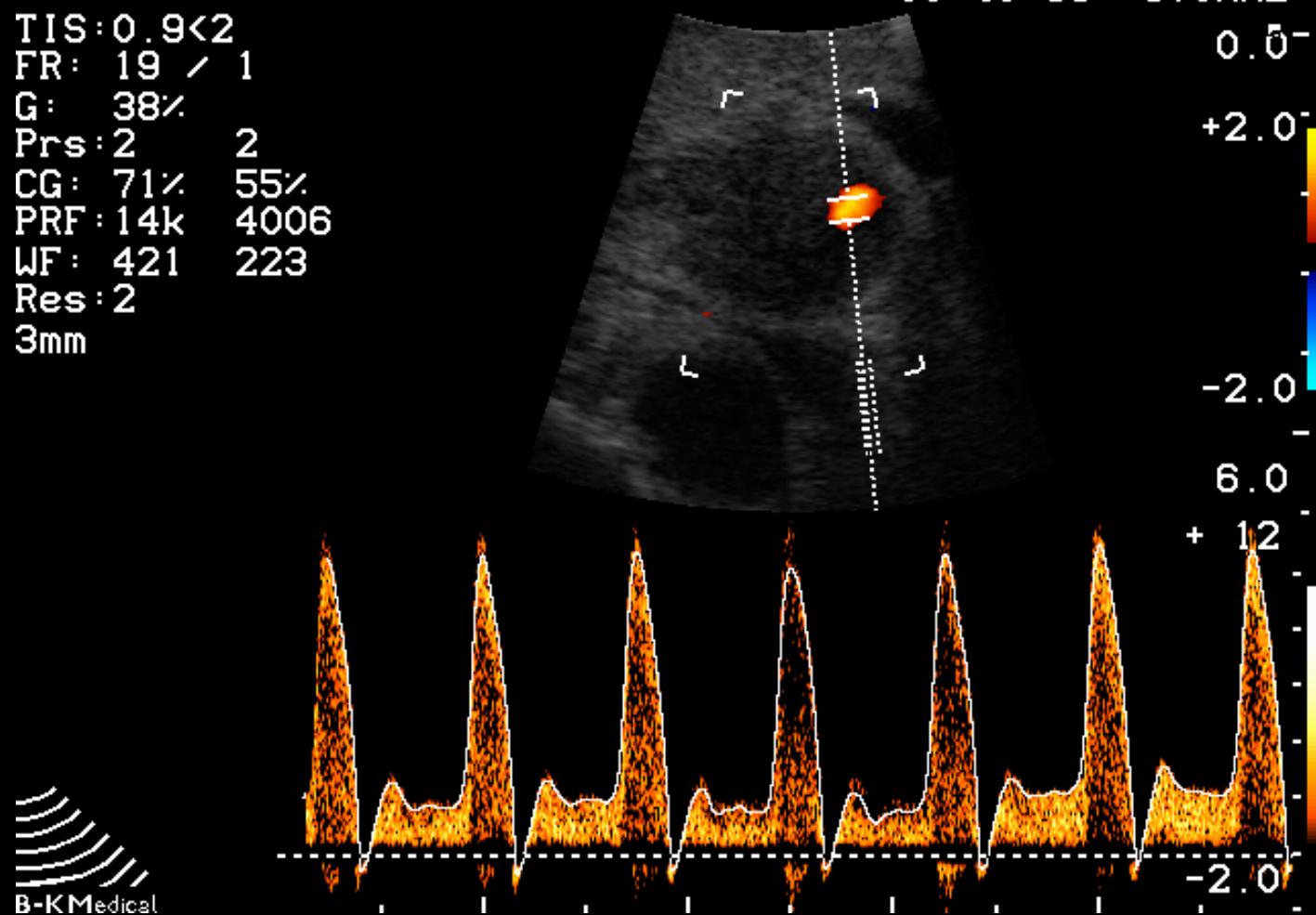
0.0-



Tumor encasement of a.hepatica

TIS: 0.9<2
FR: 19 / 1
G: 38%
Prs: 2 2
CG: 71% 55%
PRF: 14k 4006
WF: 421 223
Res: 2
3mm

11-11-2003 8666 *
□ 10:40:39 5.0MHz



Sentinel Node Lymph Nodes

KAS HERLEV KIR. AFD.

MI:1.5
FR:45
G: 67%
Prs:2

25-01-2005 8666 * KAS HERLEV KIR. AFD.
Q 9:13:44 10.0MHz

0.0- MI:1.5
FR:45
G: 67%
Prs:2

x:18.1mm
+:8.13mm ↗



x:9.24mm

25-01-2005 8666 * KAS HERLEV KIR. AFD.
Q 9:09:29 10.0MHz

0.0-



6.5 B-KMedical

B-KMedical

6.5

Retroperitoneum

HERLEV UNIV. HOSPITAL

MI:0.7
FR:25
G: 28%

1999-04-07 8544 *

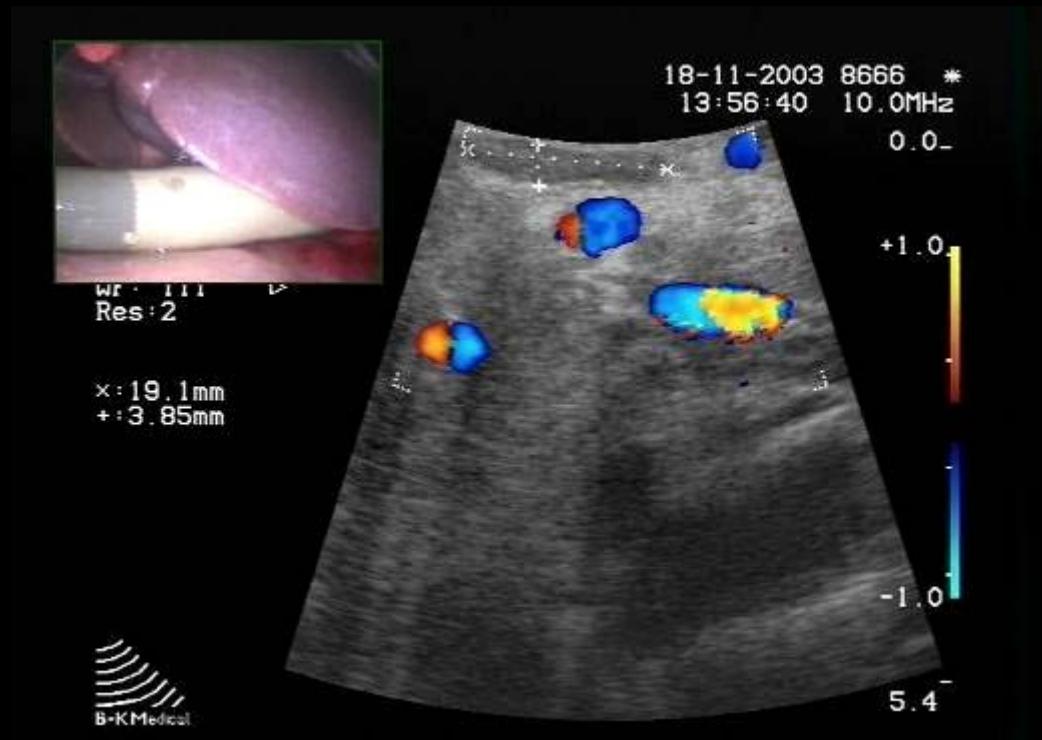
10:31:35 5.0MHz

0.0

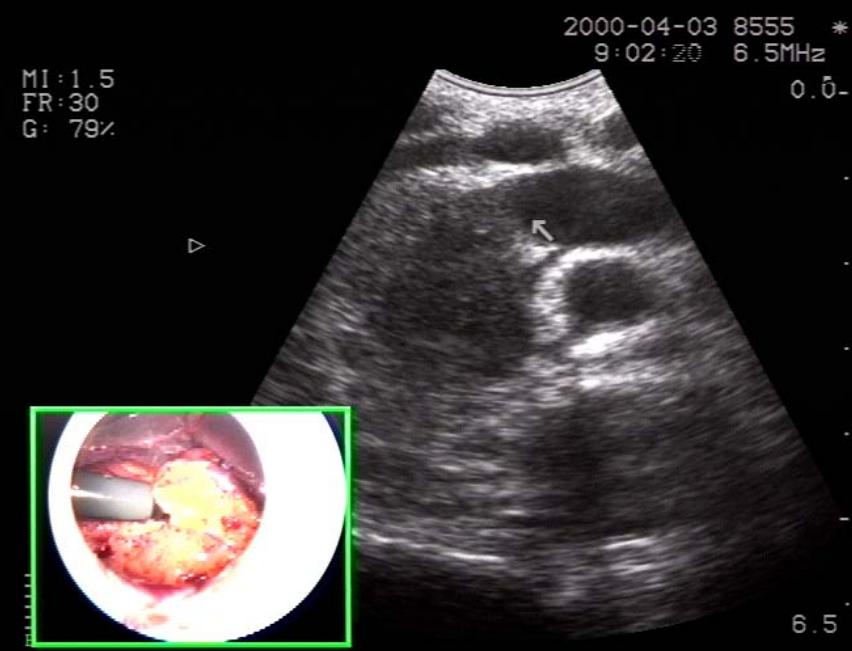


B-K Medical

LAP-LUS-CFM (Doppler)



Portal Thrombosis



Material

Perampullary/pancreatic cancers 2000-2002

110 patients possible resectability (CT and US)

m/f: 64/46

Median age: 63 years (range 37-79)

Aim

Avoid unnecessary exploration in non-resectable disease

Evaluate Non- and minimally invasive techniques in diagnosis, staging and treatment

Evaluate clinical impact and diagnostic value of LAP/LUS

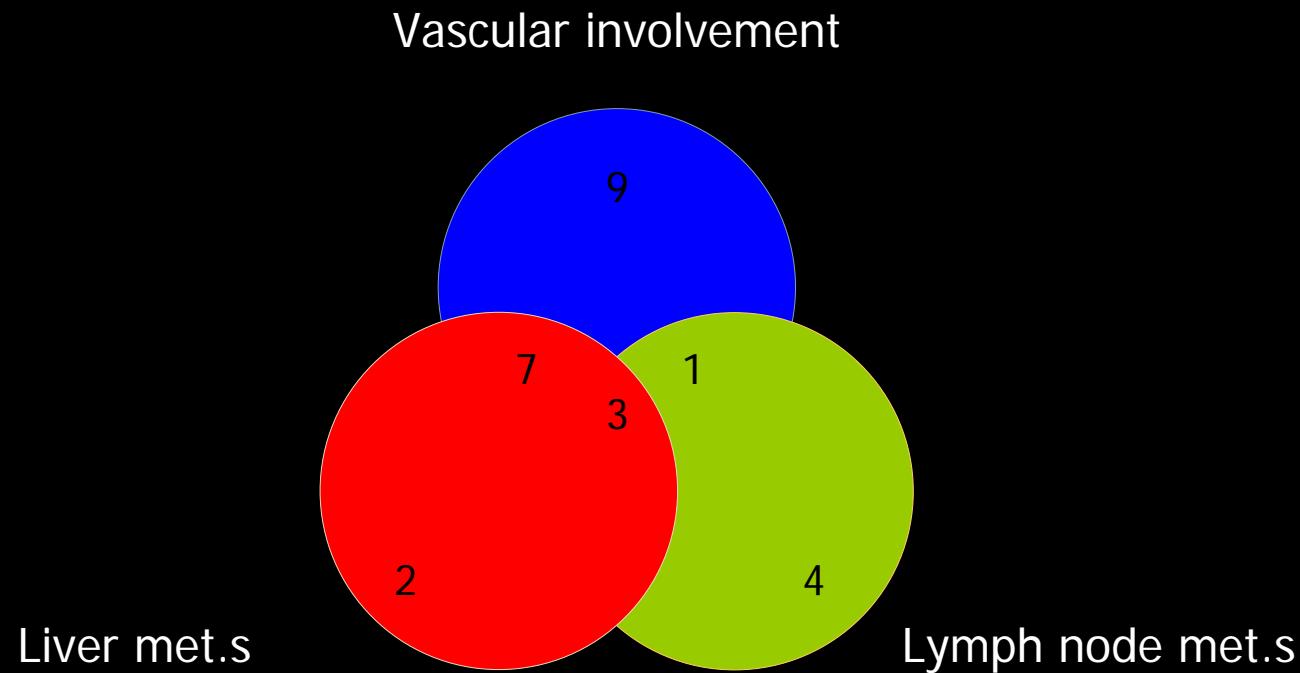
Results

42% LUS-resectable were in fact resectable with curative intend.

55% (61/110) avoided unnecessary laparotomy.

3% Benign or n.a.

Reasons for non-resectability



Predictive values of CT & LAP/LUS

Tabel 10 Oversigt over prædiktive værdier fra forskellige studier. Gengivet efter Brooks et al.⁶

Reference	N	Predictive value of		Predictive value of laparoscopy (%)
		CT (%)		
Andren- Sandberg et al.	1999	60	33	53
Bemelman et al.	1995	70	41	95 (LUS)
Conlon et al.	1996	115	53	91
Callery et al.	1997	50	52	93 (LUS)
Durup Scheel-Hincke et al.	1997	35	43	88 (LUS)
Fernandez-Del Castillo et al.	1995	114	26	93 (angiography)
John et al.	1999	50	38	68 (LUS)
Reddy et al.	1999	99	35	69
Brooks et al.	2001	145	85	92 (LUS in 55%)
Present series	2004	110	40*	55 (LAP LUS)

*95% SG: 15-65%. Beregnet på 6/15 patienter. Hos 71/110 patienter var der ikke taget stilling mht. operabilitet. Se hovedteksten.

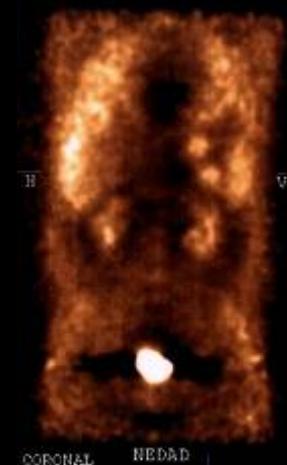
Conclusion

LAP+LUS is an essential modality in pre-operative staging of pancreatic surgery

Further improvement in staging accuracy necessary through supplementary investigations



- Better CT ?
- EUS with biopsy ?
- Contrast enhanced US ?
- PET-CT ?

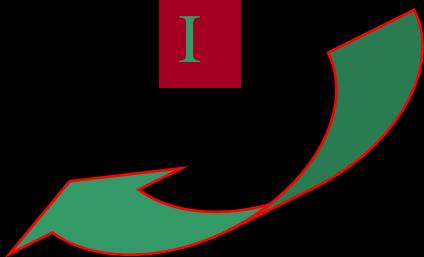


LAP-LUS guided treatment

LAP-LUS guided (RF) tumor ablation

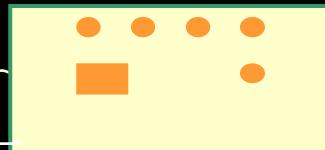
Treatment of Liver-mets? RADIOFREQUENCY ABLATION (RFA)

Dispersive
Electrode Pad

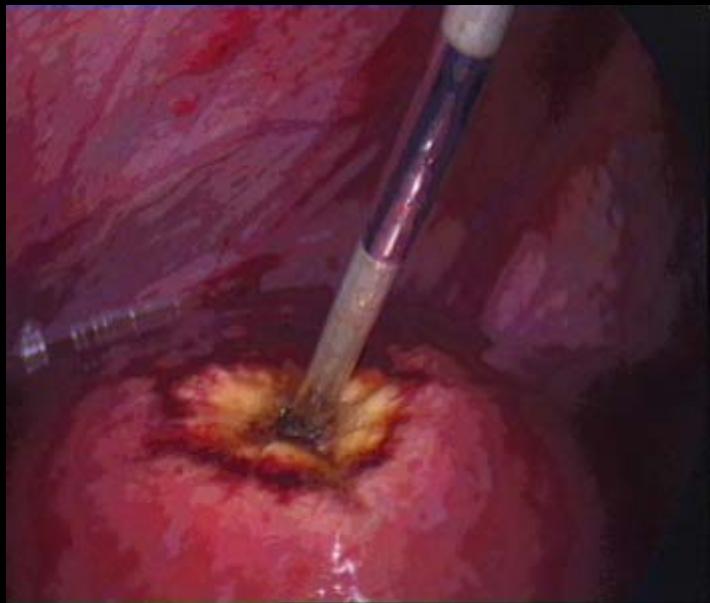


RF-
Electrode

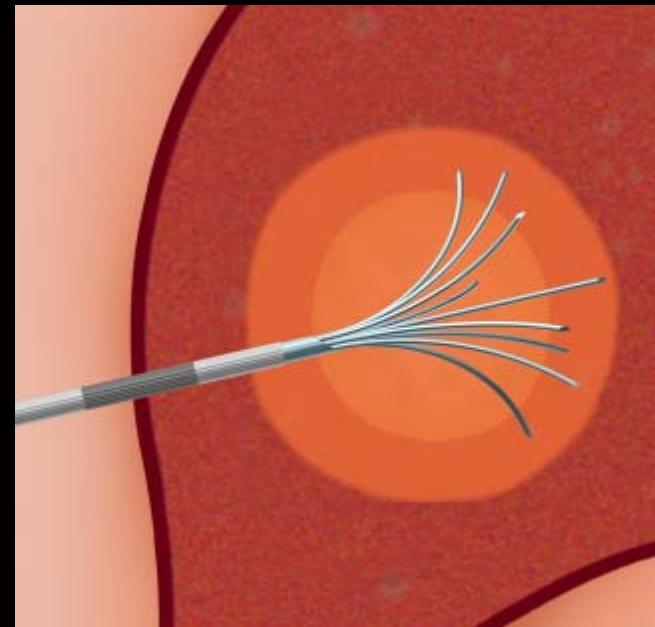
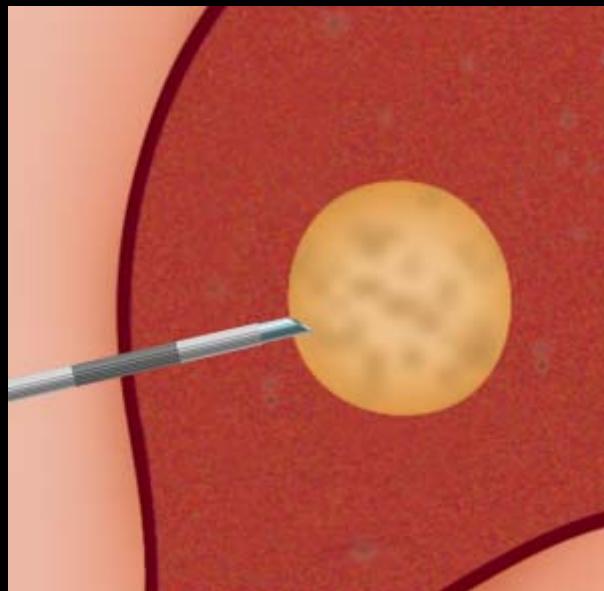
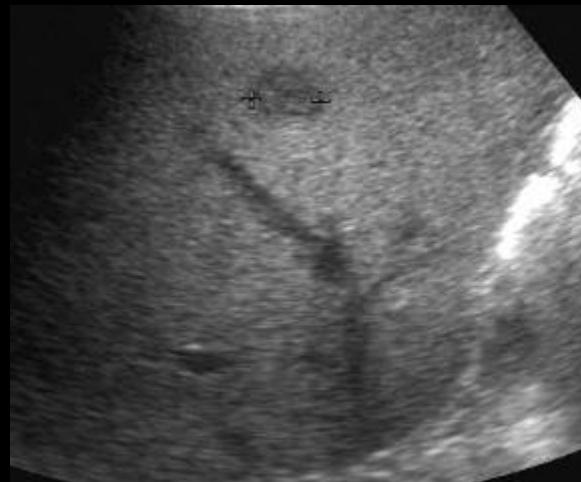
Generator



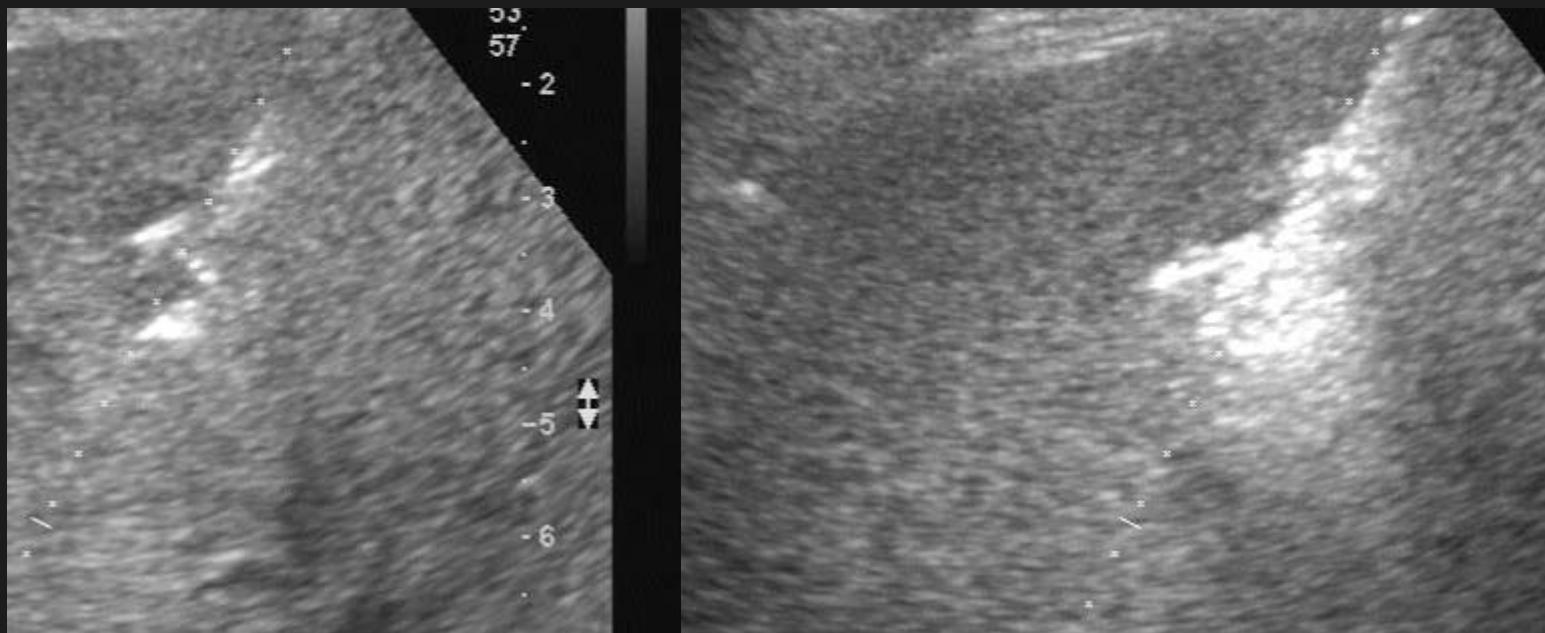
Laparoscopic Guided RFA



RFA I



RFA II



Liver Metastasis After RFA

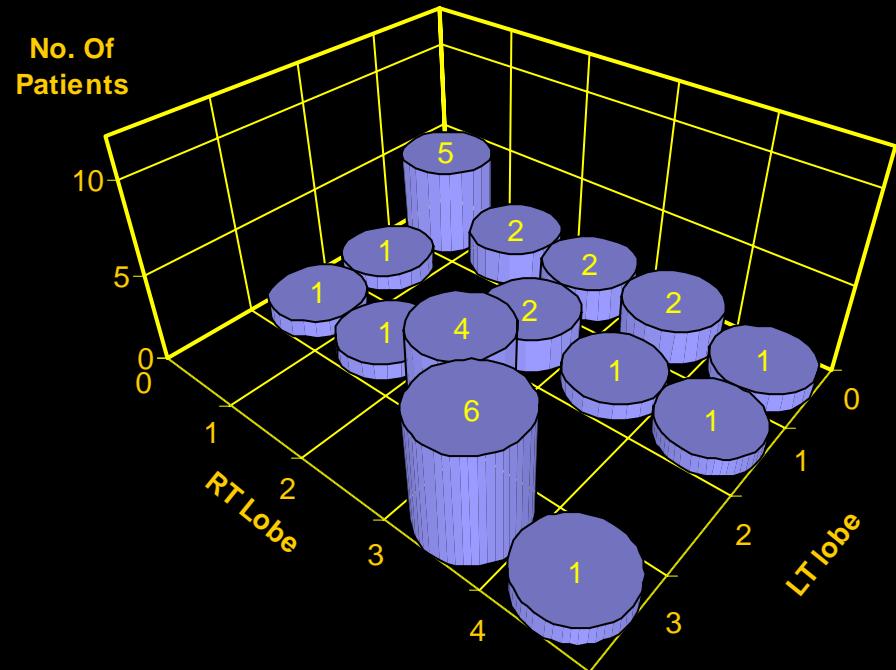
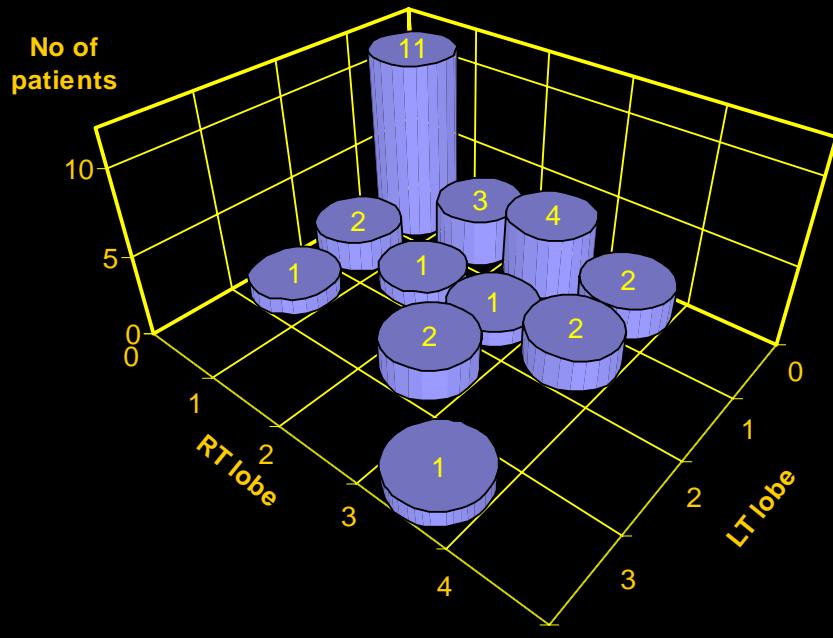


Clinical Aim US-contrast

- Improved detection of subtle Lmets
- Characterization of liver lesions
- “Guiding” Biopsies
- Per-operative Therapeutic Feed-Back
- Follow-up; Recurrency vs non-malignant sequela

Herlev 2004

Detection of liver metastasis before and after PIUS



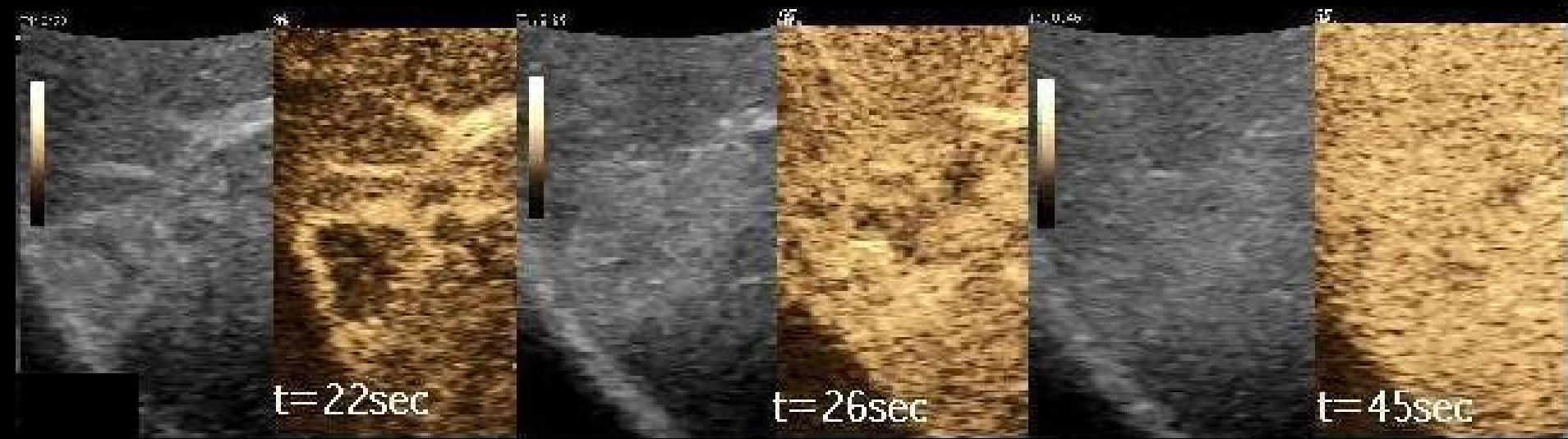
Skjoldbye B, Høgholm M, et al. Improved detection and biopsy of solid liver lesions using PIUS and contrast agent infusion.

2002;Ultrasound Med Biol; 28:439-449

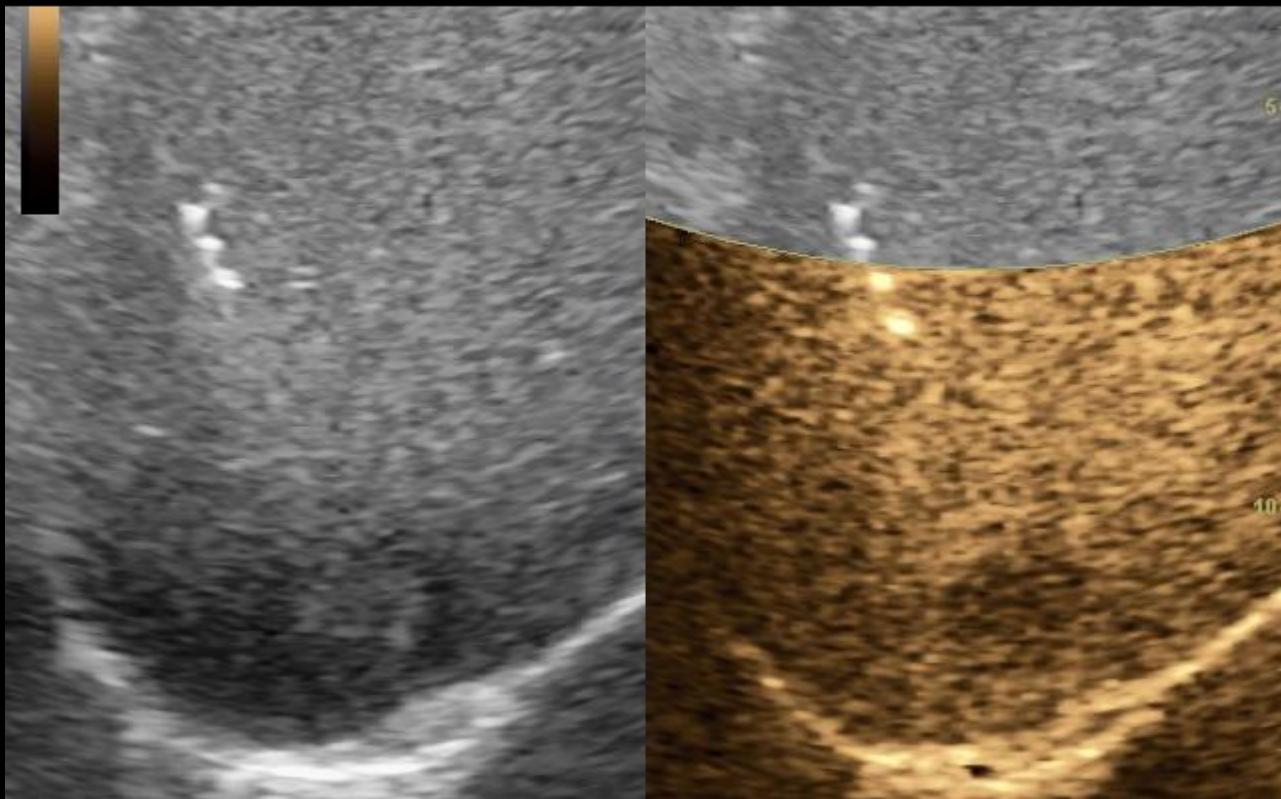
Typical Enhancement Pattern of focal liver lesions after SonoVue (i.v.)

TYPE	Arterial-	Portal-	Late-	
Haemangioma	Peripheral/ Globular			
FNH	Spoke & wheel			
Adenoma	Internal vasc. enhancement			
HCC	Strong vasc. enhancement			
Metastasis; Hyper-vascular	Peri. enhancm. Centr. necrosis			
Metastasis; Hypo-vascular	Poor enhancement			

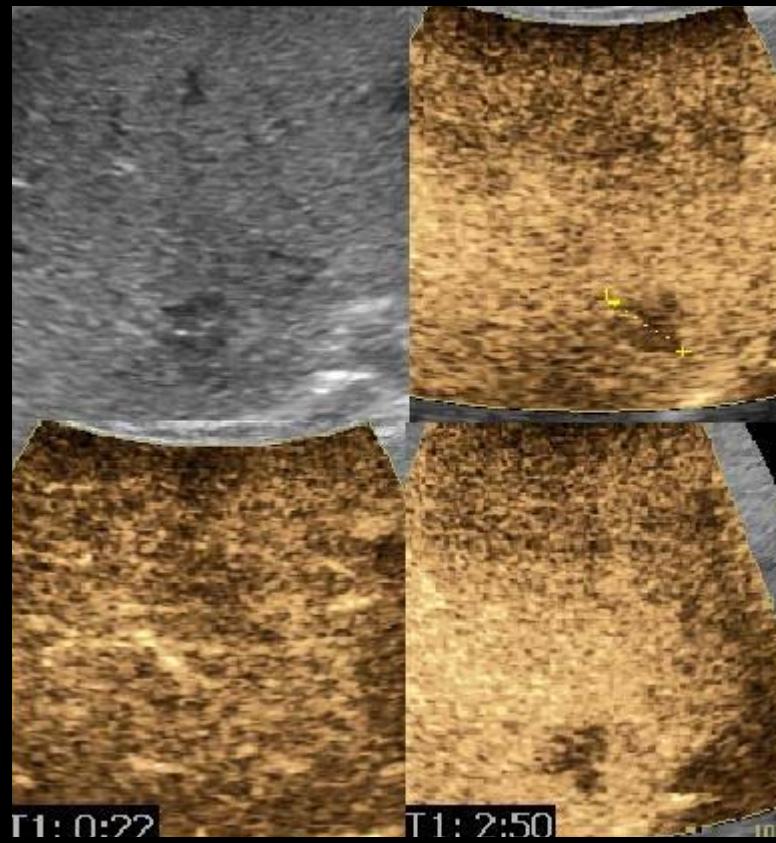
Haemangioma



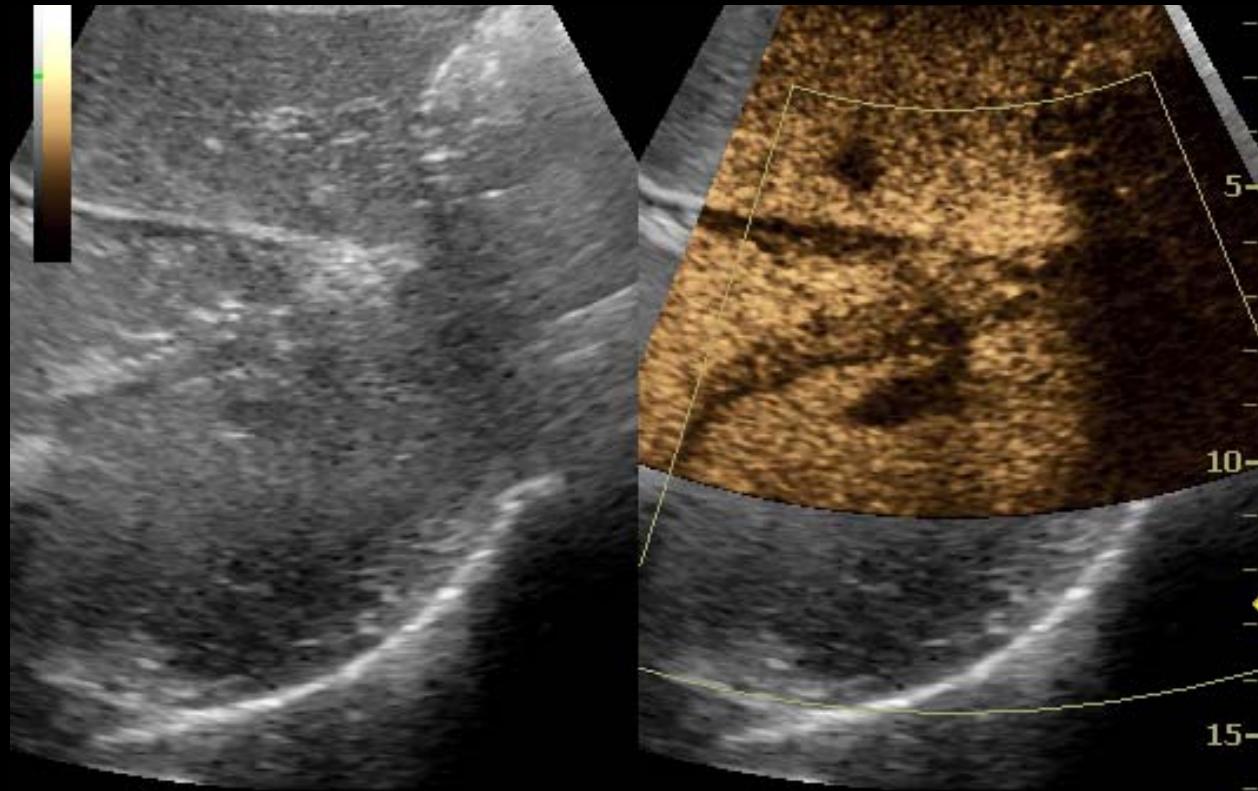
LUS contrast enhanced biopsy



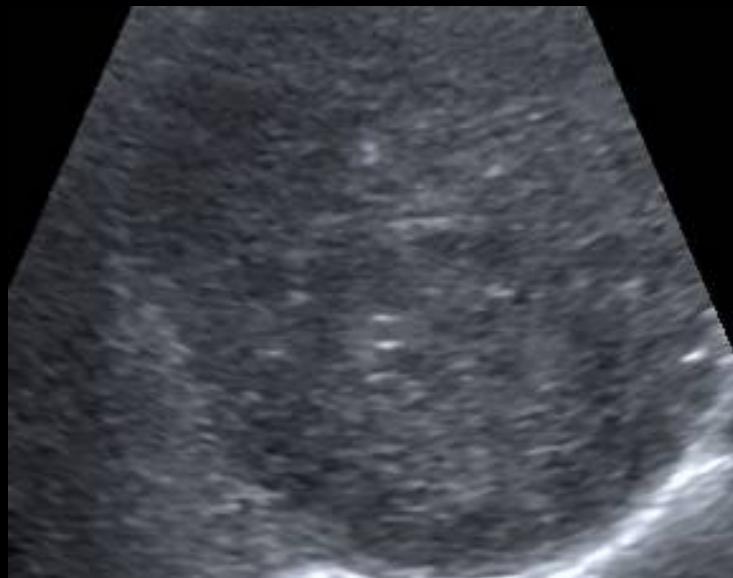
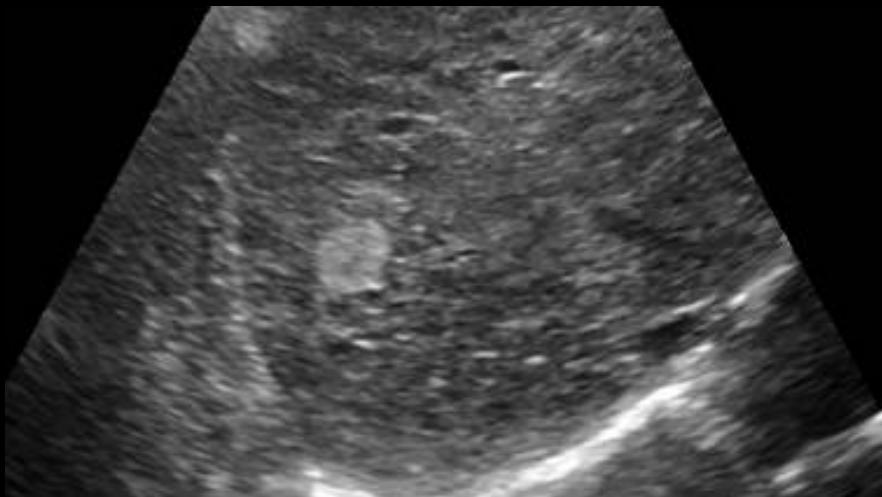
Metastasis



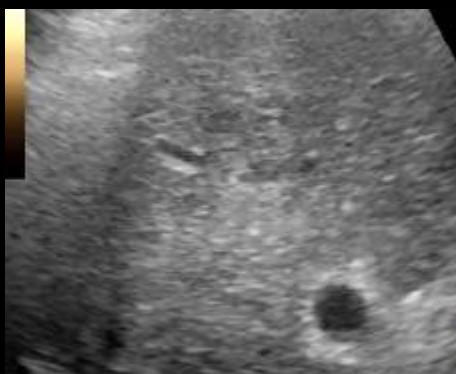
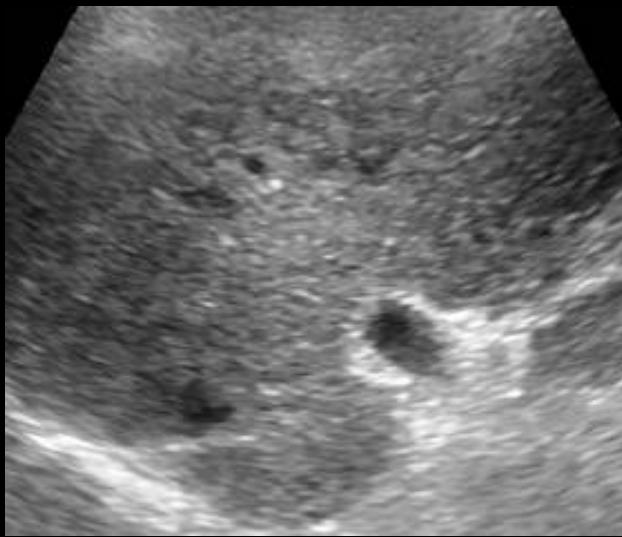
Late Phase Detection of Barely Visible Liver Metastasis



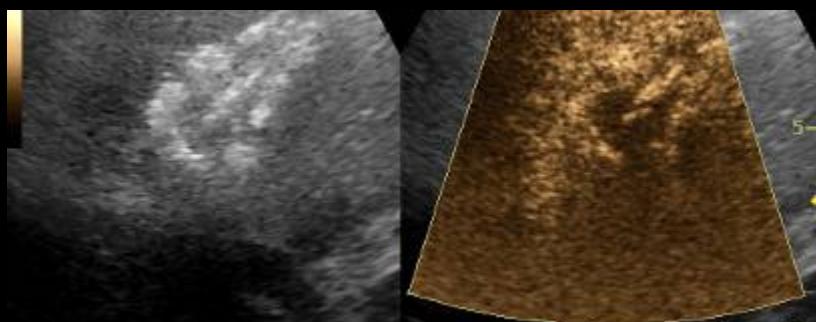
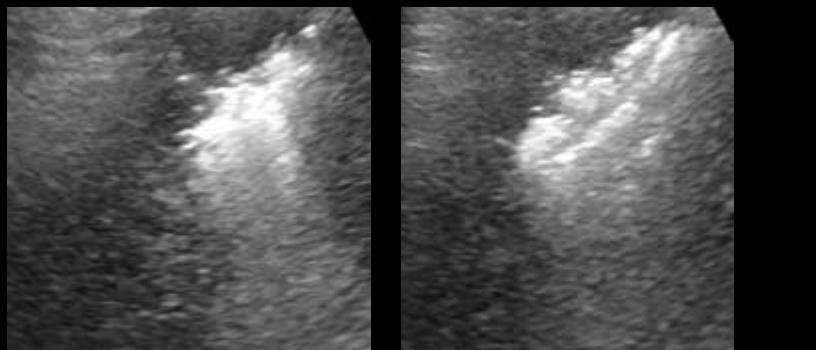
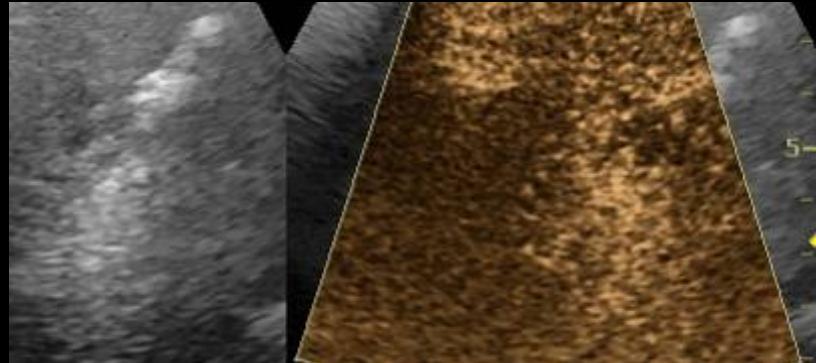
T1: 3:33



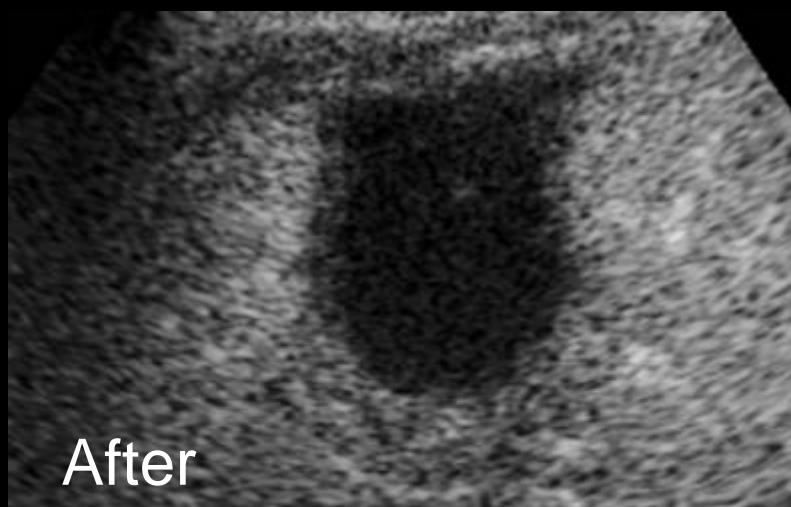
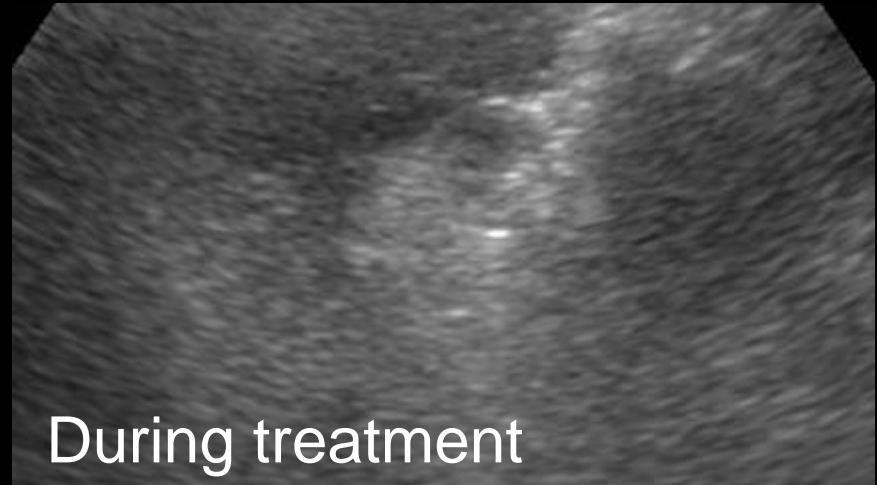
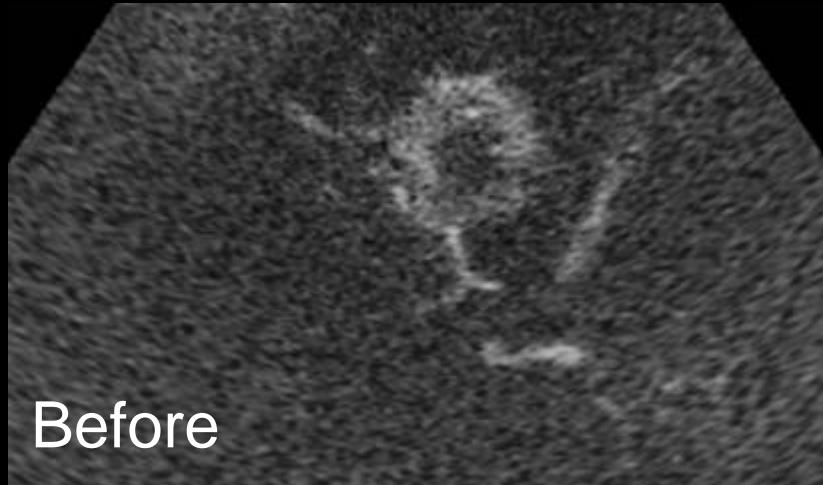
HCC & US Contrast



RFA Treatment of HCC & US Contrast



LUS Contrast & RFA



Summary

- LUS – LAP equals IUS – Laparotomy
- LUS provide in depth information
- LUS require dedicated equipment
 - High resolution imaging & Doppler
 - Biopsy
 - US-contrast
- Contrast-LUS may add advantages
 - Detection of lesions
 - Characterization of lesions
 - Treatment control



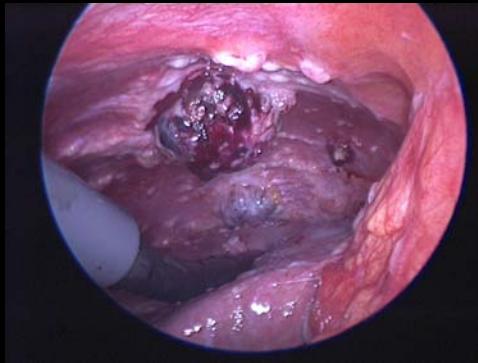
KAS HERLEV KIR. AFD.

M:1.6
FR:60
G:75%
Prs:2

24-01-2005 0659 *
0 10:02:20 6.5MHz

0.0

6.8



- What you get is what you see – and there is nothing more to it.....

– Tina Turner

