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
LUS Guided Biopsy

Needle Guide

Freehand Technique
US-contrast

• Adding an edge to LUS

• Requirements:
  – i.v access
  – Equipment capable of Contrast Harmonic
  – Contrast Media for infusion
SonoVue

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
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
Lymph Adenitis & Dilated Common Bile Duct
Pancreatic cancer - Surgical approach

- Wipple’s operation
- Palliative surgery
- Endoprotesis (stenting)
CT vs. LAP & LUS

# Diagnostic Sensitivity

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UL</td>
<td>50</td>
<td>40</td>
<td>60</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>CT</td>
<td>77</td>
<td>50</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EUS</td>
<td>100</td>
<td>62</td>
<td>33</td>
<td>17</td>
<td>100</td>
</tr>
<tr>
<td>LAP LUS</td>
<td>88</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

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

ascites

encasement

Gallbladder
Invasive growth in sup. mes. Vein
Non-resectable c.pancreatitis
Lymph Node Metastasis
Enlarged pancreatic gland
Method
Combined Laparoscopy & LUS
Carcinosis
Ascites
Carcinosis - Biopsy
Staging pancreatic cancer with Laparoscopy and Laparoscopic Ultrasound
Liver metastasis
Liver metastasis
Double duct dilatation
Portal Thrombosis and collateral flow
Doppler Imaging

Dilated pancreatic duct
Sub-centimeter Liver Metastases
Tumor enhancement 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
Sentinel Node  Lymph Nodes
Retroperitoneum
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

- Vascular involvement
- Liver met.s
- Lymph node met.s

Counts:
- Vascular involvement: 9
- Liver met.s: 7
- Lymph node met.s: 4
### Predictive values of CT & LAP/LUS

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

<table>
<thead>
<tr>
<th>Reference</th>
<th>N</th>
<th>Predictive value of CT (%)</th>
<th>Predictive value of laparoscopy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andren-Sandberg et al.</td>
<td>1999</td>
<td>60</td>
<td>33</td>
</tr>
<tr>
<td>Bemelman et al.</td>
<td>1995</td>
<td>70</td>
<td>41</td>
</tr>
<tr>
<td>Conlon et al.</td>
<td>1996</td>
<td>115</td>
<td>53</td>
</tr>
<tr>
<td>Callery et al.</td>
<td>1997</td>
<td>50</td>
<td>52</td>
</tr>
<tr>
<td>Durup Scheel-Hincke et al.</td>
<td>1997</td>
<td>35</td>
<td>43</td>
</tr>
<tr>
<td>Fernandez-Del Castillo et al.</td>
<td>1995</td>
<td>114</td>
<td>26</td>
</tr>
<tr>
<td>John et al.</td>
<td>1999</td>
<td>50</td>
<td>38</td>
</tr>
<tr>
<td>Reddy et al.</td>
<td>1999</td>
<td>99</td>
<td>35</td>
</tr>
<tr>
<td>Brooks et al.</td>
<td>2001</td>
<td>145</td>
<td>85</td>
</tr>
<tr>
<td>Present series</td>
<td>2004</td>
<td>110</td>
<td>40*</td>
</tr>
</tbody>
</table>

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
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
Detection of liver metastasis before and after PIUS


2002; Ultrasound Med Biol; 28:439-449
### Typical Enhancement Pattern of focal liver lesions after SonoVue (i.v.)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Arterial-</th>
<th>Portal-</th>
<th>Late-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemangioma</td>
<td>Peripheral/</td>
<td>Centripital</td>
<td>Iso-echoic</td>
</tr>
<tr>
<td></td>
<td>Globular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FNH</td>
<td>Spoke &amp; wheel</td>
<td>Hyper- or Iso-echoic</td>
<td>Central Scar</td>
</tr>
<tr>
<td>Adenoma</td>
<td>Internal vasc.</td>
<td>Nearly Iso-Echoic</td>
<td>Iso-hypoechoic</td>
</tr>
<tr>
<td></td>
<td>enhancement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCC</td>
<td>Strong vasc.</td>
<td>Slightly hypoechoic</td>
<td>hypoechoic</td>
</tr>
<tr>
<td></td>
<td>enhancement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metastasis;</td>
<td>Peri. enhancm.</td>
<td>Slightly</td>
<td>Strongly</td>
</tr>
<tr>
<td>Hyper-vascular</td>
<td>Centr. necrosis</td>
<td>hypoechoic</td>
<td>hypoechoic</td>
</tr>
<tr>
<td>Metastasis;</td>
<td>Poor enhancement</td>
<td>Slightly</td>
<td>Strongly</td>
</tr>
<tr>
<td>Hypo-vascular</td>
<td></td>
<td>hypoechoic</td>
<td>hypoechoic</td>
</tr>
</tbody>
</table>
Haemangioma
LUS contrast enhanced biopsy
Metastasis
Late Phase Detection of Barely Visible Liver Metastasis
HCC & US Contrast
RFA Treatment of HCC & US Contrast
LUS Contrast & RFA

Before

During treatment

After
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
• What you get is what you see – and there is nothing more to it.....
  – Tina Turner