Management of HCC

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Transplant Fellow

www.downstatesurgery.org
Objectives

A case presentation
Epidemiology of HCC
Pathogenesis of HCC
Staging
Treatment of HCC
Case report

71 YOM

A CT of the chest showed liver cirrhosis and a 2 cm mass in segment II.
PMH

No h/o transfusion

SH/FH

Married, 6 children
Alcohol: extensive history of alcohol abuse, for 52 years
Smoking: 1 PPD for 52 years
no IV drugs
No family hx of cancer
Exam

VITAL SIGNS: AF, VSS
GEN: well appearing
HEENT EXAMINATION: PERRLA, EOMI. Anicteric sclera.
NECK EXAMINATION: No lymphadenopathy, no thyromegaly
LUNGS: CTA
HEART: RRR, no M/R/G
ABDOMEN: soft, ND, NT, no ascites
EXTREMITIES: No edema
NEUROLOGIC: Non-focal, no encephalopathy
LYMPH: no cervical, clavicular, axillary or inguinal LAD
Labs

Lytes normal
BUN: 11, creatinine: 1.3
T. Protein: 7.7, albumin: 4.3
T. Bilirubin: 0.4, AST: 25, ALT: 19, alkaline phosphatase: 99
Hemoglobin: 14.5, platelets: 211, WBC: 6.2
INR 1.2

**AFP: 3**

Hepatitis serology negative for Hep B and Hep C

**Child-Pugh class = A**
- Abdominopelvic CT: Liver cirrhosis + 2 cm tm in segment 2

- Chest CT: no metastasis

- Gastroscopy & Colonoscopy: negative for primary carcinoma

- U/S guided liver biopsy revealed hepatocellular carcinoma
Surgery: laparoscopic- hand assisted segment II resection

- Postop course: no significant issue related to surgery
- d/c’ed on POD# 7
Path report

1.9 cm HCC
moderately differentiated
Cirrhotic liver
Hand-assisted laparoscopic liver resection allows the surgeon to place one hand in the abdomen while maintaining the pneumoperitoneum required for laparoscopy.
The layout of various trocar ports and Gelport in laparoscopic liver resection
Segmental anatomy according to Couinaud
The use of an ultrasonic dissector or bovie to incise Glisson’s capsule before major hepatic transection is essential before placement of endovascular staplers.
The linear stapler is closed and enables division of parenchyma and major vascular and biliary structures, providing a secure closure of significant segments of parenchyma.
The resection bed is evaluated for hemostasis.
Postresection and posthemostasis, the Biogluce is layered over the resection bed.

Biogluce: Surgical adhesive composed of purified bovine serum albumin (BSA) and glutaraldehyde
Wounds visible after completion of laparoscopic liver resection
HCC
Epidemiology of HCC

- 6th most common cancer worldwide
  - (626,000 or 5.7% of new cancer cases)
- Third most common cause of cancer mortality
  - Deaths = 598,000
- Survival rates 3% - 5% for the US and developing countries
- Fastest growing cause of cancer-related death in men in the US
  - 19,160 cases and 16,780 deaths

Epidemiology

- In the US HCC rates are Asian>African Americans>Whites
- Male>Female (2-4 fold)
  - Men are more likely to be infected with HBV and HCV, consume EtOH, smoke, have increased iron stores
- Peak age >65 in the US
- Incidence and death rates are increasing in the US

Major Risk Factors

- **HBV**
  - 5-15 fold increased risk
  - 70-90% of cases occur in setting of cirrhosis
  - Treatment does NOT decrease risk
  - Risk highest in carriers and lower in immune

- **HCV**
  - 1-3% of cirrhotic patients develop HCC
  - Treatment seems to decrease risk
  - Co-infection
    - Aflatoxins (*Aspergillus fumigatus*)
      - 4 fold increased risk HCC
  - Alcohol
    - >50-70g/day for >10 years, 5 fold increased risk
    - No link to direct carcinogenic effect
    - Synergistic with HCV and HBV, doubles the risk as compared with either infection alone

- **Nonalcoholic Steatohepatitis**


Other Risk Factors

- Obesity
- Diabetes Mellitus
- Hemochromatosis
- Alpha-1 antitrypsin deficiency
- Autoimmune hepatitis
- Porphyrias

- 15-50% of HCC in the US have no established risk factors
Pathogenesis

Occurs in setting of inflammatory condition (chronic hepatitis) or cirrhosis

Clinical symptoms for advanced stage HCC

- Right upper quadrant abdominal pain
- Early satiety
- Weight loss

Diagnose before these symptoms!!!

<20% of HCC pts are eligible for surgery
2 year survival of advanced untreated HCC: 0-15%

Llovet, Lancet, 2003
Screening (1)

The periodic performance of AFP and USG detected:

- a high proportion (71-87%) of unifocal HCC; among them, 40-61% were smaller than 3 cm in diameter and over 90% smaller than 5 cm.

S. De Mase et al. Digestive and Liver Disease, 2005
Screening (2)

- AFP/Leptin-bound AFP and USG every 3-6 months in the cirrhotic pts
- Leptin-bound AFP distinguishes true HCC from hepatocyte regeneration
- CT/MRI annually for pts with chronic hepatitis
- CT/MRI every 6 months in the cirrhotic pts

(%7-15 of HCC are detected in persons with no history of cirrhosis)

%20-56% of HCC are detected in persons in whom cirrhosis had gone undiagnosed

S.De Mase et al. Digestive and Liver Disease, 2005
Kudo M, Oncology, 2007
Diagnosis (1)

Dx of HCC can be made based on imaging findings of nodules ≥2 cm (EASL, UNOS)

Nodules ≥ 2 cm in diameter can be dx as HCC if any 2 imaging studies, including US, CT, MRI, hepatic angiography, show increased vascularity

**OR**

1 positive imaging result and AFP level > 400 ng/ ml are diagnostic


liver bx: can cause tumor spread and false-negative rate is 30-40 %.

Parikh S, Am J med, 2007
Diagnosis (2)

- AFP (normal 10-20 ng/ml) greater than 400 ng/ml is considered as diagnostic.

  - AFP (HCV+ pts): >20 ng/ml  
    sensitivity: 41-67%  
    specificity: 70-90%
  - AFP (HBsAg+ pts): >20 ng/ml  
    (non-cirrhotic pts)  
    sensitivity: 64-96%  
    specificity: 91-95%
  - USG (cirrhotic and non-cirrhotic pts):  
    (sensitivity decreases in cirrhotic livers)  
    sensitivity: 60-95%  
    specificity: 90-93%
  - USG + AFP (cirrhotic pts):  
    sensitivity: 80%  
    specificity: 87%
  - CT + AFP  
    sensitivity: 100%  
    specificity: 98.8%

- S. De Mase et al. Digestive and Liver Disease, 2005
Typical small hepatocellular carcinoma detected by computed tomography scanning. The tumor is stained at arterial phase (a) and washed out early at late phase (b).
Clinical Staging (1)

- Numerous staging systems exist
- NO CONSENSUS

- E.g. TNM, Okuda, CLIP, and BCLC, JIS

Incorporate 4 determinants of survival
- Severity of underlying liver disease
- Size of tumor
- Extension of the tumor into adjacent structures
- Presence of metastases
Clinical Staging (2)

- Primary staging should be clinical staging, and the CLIP is preferred
- Secondary staging with the AJCC - TNM staging system for patients undergoing surgery
- Staging work up includes Bone Scan and CT chest

Shouval D, Gut, 2002
### CLIP Score
(Cancer of Liver Italian Program)

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child-Pugh</strong></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td><strong>Tumor morphology</strong></td>
<td></td>
</tr>
<tr>
<td>Uninodular and extension ≤ 50%</td>
<td>0</td>
</tr>
<tr>
<td>Multinodular and extension ≤ 50%</td>
<td>1</td>
</tr>
<tr>
<td>Massive or extension &gt;50%</td>
<td>2</td>
</tr>
<tr>
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</tr>
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</tr>
<tr>
<td><strong>Portal Vein Thrombosis</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
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Prospective validation of the CLIP score: A new prognostic system for patients with cirrhosis and hepatocellular carcinoma. Hepatology 2000; 31:840
Child-Pugh Score

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bilirubin</strong></td>
<td>&lt;2</td>
<td>2-3</td>
<td>&gt;3</td>
</tr>
<tr>
<td><strong>Albumin</strong></td>
<td>&gt;3.5</td>
<td>3.5-2.8</td>
<td>&lt;2.8</td>
</tr>
<tr>
<td><strong>INR</strong></td>
<td>&lt;1.7</td>
<td>1.7-2.3</td>
<td>&gt;2.3</td>
</tr>
<tr>
<td><strong>Ascites</strong></td>
<td>Absent</td>
<td>Mild-Moderate</td>
<td>Severe / Refractory</td>
</tr>
<tr>
<td><strong>Encephalopathy</strong></td>
<td>Absent</td>
<td>Mild (I-II)</td>
<td>Severe (III-IV)</td>
</tr>
</tbody>
</table>

A=5-6 (2 yr survival 85%)
B=7-9 (2 yr survival 57%)
C=10-15 (2 yr survival 35%)

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(Cancer of Liver Italian Program)

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## TNM - AJCC

<table>
<thead>
<tr>
<th>Stage</th>
<th>T</th>
<th>N</th>
<th>M</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>T1</td>
<td>N0</td>
<td>M0</td>
<td>55% 5 yr survival</td>
</tr>
<tr>
<td>Stage II</td>
<td>T2</td>
<td>N0</td>
<td>M0</td>
<td>37% 5 yr survival</td>
</tr>
<tr>
<td>Stage IIIA</td>
<td>T3</td>
<td>N0</td>
<td>M0</td>
<td>16% 5 yr survival</td>
</tr>
<tr>
<td>Stage IIIB</td>
<td>T4</td>
<td>N0</td>
<td>M0</td>
<td></td>
</tr>
<tr>
<td>Stage IIIC</td>
<td>Any T</td>
<td>N1</td>
<td>M0</td>
<td></td>
</tr>
<tr>
<td>Stage IV</td>
<td>Any T</td>
<td>Any N</td>
<td>M1</td>
<td></td>
</tr>
</tbody>
</table>

**T definitions**
- **T1** - solitary nodule without vascular invasion
- **T2** - solitary tumor with vascular invasion or multiple nodules all <5cm
- **T3** - multinodular >5cm, or tumor with major vasculature invasion
- **T4** - Tumor with invasion of adjacent organs
**Okuda staging system for HCC**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor size</td>
<td>&gt;50%</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>Ascites</td>
<td>Clinically detectable</td>
<td>Absent</td>
</tr>
<tr>
<td>Albumin</td>
<td>&lt;3</td>
<td>&gt;3</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>&gt;3</td>
<td>&lt;3</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Stage</th>
<th>No positive</th>
<th>8.3 mos survival</th>
</tr>
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<td>Stage I</td>
<td>No positive</td>
<td>8.3 mos survival</td>
</tr>
<tr>
<td>Stage II</td>
<td>1-2 positive</td>
<td>2 mos survival</td>
</tr>
<tr>
<td>Stage III</td>
<td>3-4 positive</td>
<td>0.7 mos survival</td>
</tr>
</tbody>
</table>

Inadequate for pts with early HCC


Treatment (1)

- Primary prevention
  - Taiwan: HBV immunization of newborns introduced in 1984 resulting in decrease in incidence of HCC
    - 0.7 to 0.36 per 100,000 children
  - Infant vaccination estimated to prevent 84% of HBV related deaths
    - 94% of deaths occur from cirrhosis and HCC

Treatment (2)

*Resection and liver tx is the gold standards for the treatment of HCC*

Resection: anatomical, non anatomical, open, laparoscopic (±hand assisted)

Nonsurgical treatment: RFA, PEI, TACE

Palliative Treatment: Systemic chemotherapy, Radiation therapy
Surgical treatment of HCC

Resection
(open/laparoscopic/Hand assisted-laparoscopic)

- Right hepatectomy
- Right extended hepatectomy
- Left hepatectomy
- Left extended hepatectomy
- Left lateral hepatectomy
- Segmentectomy

Liver transplantation

DDLT
LDLT (Right lobe, left lobe, LLS)
Treatment (3) LR

Indication for resection depends on the tumor size, the number of the lesions and estimated residual liver volume.

20% to 30% of patients are eligible for resection because of advanced or multifocal disease or inadequate functional hepatic reserve.
Couinaud's segmental picture of liver.
The representative appearance of the hepatic segments separated within the liver.
# First-order division

<table>
<thead>
<tr>
<th>Anatomical Term</th>
<th>Couinaud segments referred to</th>
<th>Term for surgical resection</th>
<th>Diagram (pertinent area is shaded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Hemiliver</td>
<td>Sg 5-8(+/Sg1)</td>
<td>Right Hepatectomy OR Right Hemihepatectomy (stipulate +/-segment 1)</td>
<td><img src="image1" alt="Diagram 1" /></td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td><img src="image2" alt="Diagram 2" /></td>
</tr>
<tr>
<td>Right Liver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Hemiliver</td>
<td>Sg 2-4 (+/Sg1)</td>
<td>Left Hepatectomy OR Left Hemihepatectomy (stipulate +/-segment 1)</td>
<td><img src="image3" alt="Diagram 3" /></td>
</tr>
<tr>
<td>OR</td>
<td></td>
<td></td>
<td><img src="image4" alt="Diagram 4" /></td>
</tr>
<tr>
<td>Left Liver</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Border or watershed:** The border or watershed of the first order division which separates the two hemilivers is a plane which intersects the gallbladder fossa and the fossa for the IVC and is called the midplane of the liver.
## Second-order division

### (second-order division based on bile ducts and hepatic artery)

<table>
<thead>
<tr>
<th>Anatomical Term</th>
<th>Couinaud segments referred to</th>
<th>Term for surgical resection</th>
<th>Diagram (pertinent area is shaded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Anterior Section</td>
<td>Sg 5, 8</td>
<td>Add (-ectomy) to any of the anatomical terms as in Right anterior sectionectomy</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>Right Posterior Section</td>
<td>Sg 6, 7</td>
<td>Right posterior sectionectomy</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>Left Medial Section</td>
<td>Sg 4</td>
<td>Left medial sectionectomy OR Resection segment 4 (also see Third order) OR Segmentectomy 4 (also see Third order)</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>Left Lateral Section</td>
<td>Sg 2, 3</td>
<td>Left lateral sectionectomy OR Bisegmentectomy 2, 3 (also see Third order)</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

### Other "sectional" liver resections

<table>
<thead>
<tr>
<th>Couinaud segments referred to</th>
<th>Term for surgical resection</th>
<th>Diagram (pertinent area is shaded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sg 4-8 (+/- Sg1)</td>
<td>Right Trisectionectomy (preferred term) or Extended Right Hepatectomy or Extended Right Hemihpatectomy (stipulate +/- segment 1)</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>Sg 2, 3, 4, 5, 8 (+/- Sg1)</td>
<td>Left Trisectionectomy (preferred term) or Extended Left Hepatectomy or Extended Left Hemihpatectomy (stipulate +/- segment 1)</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Border or watershed:** The borders or watersheds of the sections are planes referred to as the right and left intersectional planes. The left intersectional plane passes through the umbilical fissure and the attachment of the falciform ligament. There is no surface marking of the right intersectional plane.
### Third-order division

<table>
<thead>
<tr>
<th>Anatomical Term</th>
<th>Couinaud segments referred to</th>
<th>Term for surgical resection</th>
<th>Diagram (pertinent area is shaded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments 1-9</td>
<td>Any one of Sg 1 to 9</td>
<td>Segmentectomy</td>
<td>![Diagram of segments 1-9]</td>
</tr>
<tr>
<td></td>
<td>(e.g. segmentectomy 6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 contiguous segments</th>
<th>Any two of Sg 1 to Sg 9 in continuity</th>
<th>Bisegmentectomy</th>
<th>![Diagram of segments 2 contiguous]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(e.g. bisegmentectomy 5,6)</td>
<td></td>
<td></td>
</tr>
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</table>

For clarity Sg. 1 and 9 are not shown. It is also acceptable to refer to ANY resection by its third-order segments, eg. right hemihepatectomy can also be called resection sg 5-8.

**Border or watersheds:** The borders or watersheds of the segments are planes referred to as intersegmental planes.
Factors that affect survival of patients with HCC after LR

Tumor size and number
Vascular invasion
**Poor functional status** (Total bilirubin levels, albumin level, PT)
AFP level
Nodal metastases
Age (</>65)
Treatment modality
HCV+/-

Thorgeirsson. J Hepatology. 2006. 44:798
Good results after Liver tx were only confirmed for patients fulfilling the Milan or UCSF criteria.
Indication for liver Tx

(LDLT/ DDLT)

Milan criteria;
1 tm < 5 cm or \( \leq 3 \) tm each \( \leq 3 \) cm
5 year survival: % 55-84

UCSF criteria:
1 tm \( \leq 6.5 \) cm; or three or fewer tumors, the largest of which is \( \leq 4.5 \) cm with the sum of the tumor diameters \( \leq 8 \) cm
5 year survival: % 40-65

LR vs Liver Tx

Cirrhotic liver is prone to develop multicentric carcinoma and 75% of patients develop intrahepatic recurrence within 5 years of apparently curative resection.

intrahepatic recurrence after liver tx (%10-20) in less than LR

Poon RT, Ann Surg, 2000
Treatment (5)

Liver tx

Shortage of the liver grafts for transplantation

Wait time > 6-12 months

20 % drop out due to progression of the HCC during wait time (Downstaging before liver tx by TACE, RFA or both)

Salvage liver transplantation !!

LR for HCC and liver transplantation for hepatic recurrence
Dx of Recurrence (LR/LTx)

Screening for recurrence: AFP and USG (CT/MRI) every 3-6 months.

CT/MRI/Angio for new lesions appeared on the USG.
5 year Survival
(Milan criteria-with compensated cirrhosis)

LT 60-80%
Lovet JM, Semin Liver Dis, 2005
Ravaiolo M, Liver Transplant, 2004

Liver resection 70-75%
Lovet JM, Hepatology, 1999
Cha CH, Ann Surg, 2003
Bridge therapies for pts for Liver tx on the waiting list

TACE
RFA
PEI
TACE

Absolute Contraindications for TACE:

Absence of hepatopetal blood flow (portal vein thrombosis)
Encephalopathy, and biliary obstruction

Relative Contraindications for TACE

bilirubin >2 mg/dL
Lactate dehydrogenase >425 U/L
Aspartate aminotransferase >100 U/L
Tumor burden involving >50 percent of the liver
Cardiac or renal insufficiency
Ascites, recent variceal bleed, or significant thrombocytopenia

2 yr survival 24-63%

www.downstatesurgery.org
RFA (1)

Surgical / percutaneous / laparoscopic

It is an image-guided (USG/CT/MTI) technique that heats and destroys cancer cells.

High-frequency electrical currents are then passed through the electrode, creating heat that destroys the abnormal cells.
RFA (2)

INDICATIONS

- Bridge therapy for liver transplant
- Tumor is difficult to reach with surgery
- Other medical conditions that make surgery especially risky.
- Would not have enough liver tissue left for the organ to function adequately following the surgical removal of a tumor.
- Liver tumors that have not responded to chemotherapy or that have recurred after being removed surgically.

**most effective treating ≤ 3 tumors each ≤ 3 cm**

Problems related to RFS: infection, bleeding, organ injury, liver abscess, pain
Pure alcohol is injected into liver cancers to kill the cancer cells. The alcohol is injected through the skin into the tumor using a very thin needle with the help of ultrasound or CT visual guidance.

Alcohol induces tumor destruction by drawing water out of tumor cells (dehydrating them) and thereby altering (denaturing) the structure of cellular proteins. It may take up to five or six sessions of injections to completely destroy the cancer.
The ideal patient for alcohol injection has fewer than three HCC tumors, each of which is:

- well defined (distinct margins)
- less than 3cm in diameter
- surrounded by a shell consisting of scar tissue (fibrous encapsulation)
- not near the surface of the liver

- Patients with HCC undergoing alcohol injection should have no signs of chronic liver failure, such as ascites or jaundice.
Side effects of PEI:

Leakage of alcohol onto the surface of the liver and into the abdominal cavity, thereby causing pain and fever.

Avoid injuring adjacent blood vessels and bile ducts.
Curative Treatments for Early Stage HCC

• Liver transplantation / Resection
  5 yr survival 41-93%

• Radiofrequency ablation (RFA)
  5 yr survival 33-40%
  - Solitary tumors, max 3-5cm

• Percutaneous ethanol or acetic acid ablation
  5 yr survival 29-71%
  - Solitary tumors, max 3-5cm

• Transarterial chemoembolization (TACE)
  - 2 yr survival 24-63%
Palliative Treatment for Advanced Stage HCC

- Systemic chemotherapy
- Radiation therapy
Systemic Chemotherapy for Advanced HCC

- HCC has been considered to be a relatively chemotherapy refractory tumor
- Survival is often determined by degree of hepatic dysfunction
- Systemic chemotherapy not well tolerated by patients with significant underlying hepatic dysfunction
Treatment Algorithm

HCC

Stage 0
PST 0, Child-Pugh A, Okuda 1

Very early stage (0)
1 HCC <2 cm
Carcinoma in situ

1 HCC
Portal pressure/bilirubin
Increased
Normal

Early stage (A)
1 HCC or 3 nodules <3 cm, PST 0

3 nodules ≤3 cm
Increased
Associated diseases

Intermediate stage (B)
Multinodular, PST 0

No
Yes

Advanced stage (C)
Portal invasion, N1, M1, PST 1–2

No
Yes

Terminal stage (D)

Resection
Liver transplantation *
PEI/radiofrequency
Chemoembolisation
New agents

Curative treatments
Randomised controlled trials
Symptomatic treatment

Llovet et al. Lancet, December 2003, Pages 1907-1917
Evaluation of 300 minimally invasive liver resections at a single institution: less is more.

Koffron AJ, Auffenberg G, Kung R, Abecassis M.

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- largest, single center experience to date of minimally invasive liver resection (MILR)

- MILR, comparing them to their open counterparts

- 300 MILR and 100 open were performed between July 2001 and November 2006

- 241 pure laparoscopic, 32 hand-assisted laparoscopic, and 27 laparoscopy-assisted open (hybrid) resections.

- Benign etiologies encompassed cysts (70), hemangiomata (37), focal nodular hyperplasia (FNH) (23), adenomata (47), and 20 live donor right lobectomies.

- Malignant etiologies included primary (43) and metastatic (60) tumors.

- Hepatic fibrosis/cirrhosis was present in 25 of 103 patients with malignant diseases (24%).
<table>
<thead>
<tr>
<th>Type of Resection by Surgical Technique Utilized</th>
<th>PLR</th>
<th>HALR</th>
<th>LAOR</th>
<th>MILR</th>
<th>Total</th>
<th>Open</th>
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<tbody>
<tr>
<td>Segmentectomy</td>
<td>108</td>
<td>0</td>
<td>2</td>
<td>110</td>
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<td>38</td>
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<td>63</td>
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<td>Left hepatectomy (Sg 2–4)</td>
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<td>10</td>
<td>0</td>
<td>47</td>
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<td>12</td>
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<td>Right hepatectomy (Sg 5–8)</td>
<td>29</td>
<td>12</td>
<td>23</td>
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<td>38</td>
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<td>Right trisectionectomy (Sg 4–8)</td>
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<td>0</td>
<td>8</td>
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<td>3</td>
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<td>Caudate lobectomy</td>
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<td>0</td>
<td>8</td>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
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<td>32</td>
<td>27</td>
<td>300</td>
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<td>100</td>
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<td>Procedure</td>
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<td>Benign Solid</td>
<td>Malignant</td>
<td>Other</td>
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<td>20</td>
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<tr>
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<td>24</td>
<td>11</td>
<td>20</td>
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<td>4</td>
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<td>0</td>
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<tr>
<td>Caudate lobectomy</td>
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<td>4</td>
<td>2</td>
<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>70</strong></td>
<td><strong>107</strong></td>
<td><strong>103</strong></td>
<td><strong>20</strong></td>
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<td>PLR</td>
<td>HALR</td>
<td>LAOR</td>
<td>Open</td>
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<tr>
<td>Segmentectomy</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>2</td>
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<td></td>
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<tr>
<td>Bisegmentectomy</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left hepatectomy</td>
<td>0</td>
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<td>0</td>
<td>2</td>
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<tr>
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<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>5</td>
<td>2</td>
<td>7</td>
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<td>TABLE 5. Surgical Outcomes/Complications by Surgical Technique Used</td>
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<tr>
<td></td>
<td>PLR</td>
<td>HALR</td>
<td>LAOR</td>
<td>Open</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(241)</td>
<td>(32)</td>
<td>(27)</td>
<td>(100)</td>
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<tr>
<td>Operative time [mean (min)]</td>
<td>95</td>
<td>82</td>
<td>157</td>
<td>182</td>
<td></td>
<td></td>
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<tr>
<td>Blood loss [mean (cc)]</td>
<td>100</td>
<td>82</td>
<td>150</td>
<td>325</td>
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<tr>
<td>Transfusion [mean (units RBC)]</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>8</td>
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<tr>
<td>LOS [mean (d)]</td>
<td>1.7</td>
<td>2.1</td>
<td>3.4</td>
<td>5.4</td>
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<tr>
<td>Bile leaks (no. patients)</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>Conversion (no. patients)</td>
<td>20*</td>
<td>0</td>
<td>2</td>
<td>NA</td>
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</tr>
</tbody>
</table>

*Conversion from PLR to HALR.
### TABLE 7. Hospital Costs by Resection Type and Surgical Technique Used

<table>
<thead>
<tr>
<th>Resection Type</th>
<th>Technique</th>
<th>THC</th>
<th>ORC</th>
<th>Non-ORC</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial</td>
<td>Open</td>
<td>1.00 (0.44)</td>
<td>0.39 (0.19)</td>
<td>0.61 (0.28)*</td>
<td>2.9 (0.9)</td>
</tr>
<tr>
<td></td>
<td>MILR</td>
<td>0.98 (0.24)</td>
<td>0.50 (0.21)</td>
<td>0.48 (0.09)*</td>
<td>2.3 (0.5)</td>
</tr>
<tr>
<td>Right lobe</td>
<td>Open</td>
<td>1.00 (0.43)</td>
<td>0.36 (0.13)</td>
<td>0.64 (0.32)*</td>
<td>2.8 (1.3)</td>
</tr>
<tr>
<td></td>
<td>MILR</td>
<td>0.66 (0.31)</td>
<td>0.31 (0.06)</td>
<td>0.35 (0.07)*</td>
<td>2.0 (0.7)</td>
</tr>
</tbody>
</table>

Data represent means and (standard deviation) of 10 representative cases for each category.

*P < 0.0001 (correlation with LOS).
Conclusion

• both clinical and financial outcomes for MILR compare favorably with those of the open standard technique.

• MILR of varying magnitudes is safe and both clinically and cost effective for the management of both benign and malignant lesions.
Minor versus major hepatic resection for small hepatocellular carcinoma (HCC) in cirrhotic patients: A 20-year experience.

Dahiya D, et al.

Department of General Surgery, Division of Transplantation and Liver Surgery, Chang Gung Memorial Hospital Linkou Medical Center, Linkou, Taiwan.

- The choice between minor versus major resection or anatomic versus nonanatomic resection for small (<5 cm) solitary HCC in patients with cirrhosis is controversial.

- The aim of the study was to evaluate the long-term disease-free survival (DFS) and overall survival (OS) after minor or major hepatic resection for small solitary HCC in cirrhotic patients.

- Between January 1983 and December 2002, patients with solitary HCC of ≤5 cm in size who had histologically proven liver cirrhosis

- minor (≤2 segments) or major (≥3 segments) hepatectomy.

- total 373 patients; 259 underwent minor and 114 underwent major hepatectomy. Patients in the minor resection group had more severe underlying liver disease.
Table II. Types of operative procedures in the minor and major hepatectomy groups

- Surgical procedure

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Minor hepatectomy (n = 259)</th>
<th>Major hepatectomy (n = 114)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enucleation</td>
<td>5 (29.0%)</td>
<td>—</td>
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<tr>
<td>Monosegmentectomy</td>
<td>163 (62.9%)</td>
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<tr>
<td>Bisegmentectomy</td>
<td>21 (8.1%)</td>
<td>—</td>
</tr>
<tr>
<td>Trisegmentectomy</td>
<td>—</td>
<td>33 (28.9%)</td>
</tr>
<tr>
<td>Right hepatectomy</td>
<td>—</td>
<td>41 (36.0%)</td>
</tr>
<tr>
<td>Extended right hepatectomy</td>
<td>—</td>
<td>4 (3.5%)</td>
</tr>
<tr>
<td>Left hepatectomy</td>
<td>—</td>
<td>33 (28.9%)</td>
</tr>
<tr>
<td>Extended left hepatectomy</td>
<td>—</td>
<td>3 (2.6%)</td>
</tr>
<tr>
<td>Anatomic resection</td>
<td>76 (29.3%)</td>
<td>83 (72.8%)</td>
</tr>
<tr>
<td>Nonanatomic resection</td>
<td>183 (70.7%)</td>
<td>31 (27.2%)</td>
</tr>
</tbody>
</table>
Fig 2. Cumulative DFS curves in patients with major and minor resection.
Fig 3. Cumulative OS curves in patients with major and minor resection.
The type of operative resection was not found to be a significant factor affecting survival, but the preoperative liver function, tumor characteristics (alpha-feto protein, size, and presence of daughter nodules), were found to be independent factors that affect the DFS and OS in a multivariate analysis.
Conclusion

They recommend conservative liver resection for single, small (<5 cm) HCC over major resection in patients who have limited functional hepatic reserve.

This technique provides equal rates of disease-free and long-term survival.
Thank You