Disclosure

Speaker name:
Prof. Maciej Pech

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)

- I do not have any potential conflict of interest
Percutaneous tumor ablation: indications and technical innovations

Maciej Pech
Klinik für Radiologie und Nuklearmedizin
Universitätsklinikum Magdeburg
Maslow's hierarchy of needs

Abraham Maslow once said:
"If your tool kit (-box) only consists of a hammer, you tend to see a nail in every problem".
Microtherapy – Toolbox

- Surgery
- Toolbox Microtherapy
- Systemic Chemotherapy

Local Cytoreduction
- Thermal Devices
  - Radiofrequency
  - Microwave
  - Cryoablation
- Non-thermal Devices
  - Interstitial Brachytherapy
  - IR-Electroporation
  - High-Precision RT

Locoregional Cytoreduction
- Embolic Devices
  - Radioembolisation SIRT
  - Chemoembolisation TACE/Beads
- Local Chemotherapy

## Percutaneous tumor ablation

<table>
<thead>
<tr>
<th>Device</th>
<th>Image guidance</th>
<th>Multiple Catheter</th>
<th>Higher local recurrence rates</th>
<th>RCTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFA</td>
<td>US, CT, MRI, open</td>
<td>++</td>
<td>&gt; 3 cm (or &gt; 5 cm)&lt;br&gt;Wu Y 2011</td>
<td>1 (Ø HCC)</td>
</tr>
<tr>
<td>MWA</td>
<td>US, CT, open</td>
<td>++</td>
<td>&gt; 3 cm (or &gt; 5 cm)&lt;br&gt;Groesch RT 2013</td>
<td>0</td>
</tr>
<tr>
<td>Brachytherapy</td>
<td>US, CT, MRI</td>
<td>+++</td>
<td>Dose rate depended&lt;br&gt;Colletini F 2013</td>
<td>0</td>
</tr>
<tr>
<td>IRE</td>
<td>US, MRI, open</td>
<td>+++</td>
<td>No data</td>
<td>0</td>
</tr>
<tr>
<td>Cryoablation</td>
<td>US, CT, open</td>
<td>++</td>
<td>&gt; 3 cm (or &gt; 5 cm)&lt;br&gt;Littruo TJ 2016</td>
<td>0</td>
</tr>
</tbody>
</table>
Portal pressure/ bilirubin

HCC

Stage 0
PS 0, Child–Pugh A

Stage A–C
PS 0–2, Child–Pugh A–B

Stage D
PS > 2, Child–Pugh C

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

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

Intermediate stage (B)
Multinodular, PS 0

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

End stage (D)

1 HCC
Portal pressure/ bilirubin

Increased
Associated diseases

Normal
No
Yes

Resection
Liver transplantation
RFA
TACE
Sorafenib
BSC

Target: 40%
OS: 20 mo (14-45)
Target: 40%
OS: 11 mo (6-14)
Target: 10%
OS: <3 mo

Curative treatments (30%)
5-year survival (40–70%)

PS, performance status; TACE, transarterial chemoembolization; BSC, Best Supportive Care
ESMO guidelines 2012

HCC in cirrhosis

Child–Pugh A, PS 0
- Very early stage
  - 1 HCC < 2 cm
  - Curative treatments (resection, RFA, transplantation)

Child–Pugh A–B, PS 0–2
- Early stage
  - 1 HCC or 3 nodules < 3 cm
  - Intermediate stage
    - Multinodular, PS 0
    - TACE

Child–Pugh C, PS > 2
- Advanced stage
  - Portal invasion, nodal involvement, metastases, PS 1–2
  - Sorafenib
- Terminal stage
  - Symptomatic treatment

PS, performance status; RFA = radiofrequency ablation; TACE, transarterial chemoembolization
Verslype et al., ESMO guidelines Annals of Oncology 23 (Supplement 7): vii41–vii48
A Prospective Randomized Trial Comparing Percutaneous Local Ablative Therapy and Partial Hepatectomy for Small Hepatocellular Carcinoma

Min-Shan Chen, MD,*† Jin-Qing Li, MD,*† Yun Zheng, MD,*† Rong-Ping Guo, MD,*† Hui-Hong Liang, MD,*† Ya-Qi Zhang, MD,*† Xiao-Jun Lin, MD,*† and Wan Y. Lau, MD†

<table>
<thead>
<tr>
<th></th>
<th>N= 230</th>
<th>1-Year</th>
<th>2-Years</th>
<th>3-Years</th>
<th>4-Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HCC ≤ 5 cm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RES</td>
<td>DFS / OS</td>
<td>86,6 / 93,3%</td>
<td>76,8 / 82,3%</td>
<td>69,0 / 73,4%</td>
<td>51,6 / 64,0%</td>
</tr>
<tr>
<td>RFA</td>
<td>DFS / OS</td>
<td>85,9 / 95,8%</td>
<td>69,3 / 82,1%</td>
<td>64,1 / 71,4%</td>
<td>46,4 / 67,9%</td>
</tr>
</tbody>
</table>

n.s. also in Subgroup Analysis < 3cm and 3-5cm
A Randomized Trial Comparing Radiofrequency Ablation and Surgical Resection for HCC Conforming to the Milan Criteria

Jiwei Huang, MD, Lynan Yan, MD, Zheyu Cheng, MD, Hong Wu, MD, Liang Du, PhD, Jinzhou Wang, Yinglong Xu, and Yong Zeng, MD

<table>
<thead>
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<th>N= 230 N= 230</th>
<th>DFS / OS</th>
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<tr>
<td>1-Year</td>
<td>2-Years</td>
<td>3-Years</td>
</tr>
<tr>
<td>RES</td>
<td>85,2 / 98,3%</td>
<td>73,9 / 96,5%</td>
</tr>
<tr>
<td>RFA</td>
<td>81,7 / 87,0%</td>
<td>59,1 / 76,5%</td>
</tr>
</tbody>
</table>

p= 0,001 and p=0,017; also in Subgroups < 3cm und 3-5cm
Resection vs. RFA in early HCC

Image Guidance/Navigation (?)
Needle positioning under MRI - Control
Success control in 2 directions
Hepatic Resection Versus Radiofrequency Ablation for Very Early Stage Hepatocellular Carcinoma: A Markov Model Analysis

Yun Ku Cho,1 Jae Kyun Kim,2 Wan Tae Kim,1 and Jin Wook Chung3

No adequate randomized trials have been reported for a comparison between hepatic resection (HR) versus radiofrequency ablation (RFA) for the treatment of patients with very early stage hepatocellular carcinoma (HCC), defined as an asymptomatic solitary HCC <2 cm. For compensated cirrhotic patients with very early stage HCC, a Markov model was created to simulate a randomized trial between HR (group I) versus primary percutaneous RFA followed by HR for cases of initial local failure (group II) versus percutaneous RFA monotherapy (group III); each arm was allocated with a hypothetical cohort of 10,000 patients. The primary endpoint was overall survival. The estimates of the variables were extracted from published articles after a systematic review. In the parameter estimations, we assumed the best scenario for HR and the worst scenario for RFA. The mean expected survival was 7.577 years, 7.564 years, and 7.356 years for group I, group II, and group III, respectively. One-way sensitivity analysis demonstrated that group II was the preferred strategy if the perioperative mortality rate was greater than 1.0%, if the probability of local recurrence following an initial complete ablation was <1.9% or if the positive microscopic resection margin rate was >0.3%. The 95% confidence intervals for the difference in overall survival were −0.18-0.18 years between group I and II, 0.06-0.36 years between group I and III, and 0.13-0.30 years between group II and III, respectively. Conclusion: Primary percutaneous RFA followed by HR for cases of initial local failure was nearly identical to HR for the overall survival of compensated cirrhotic patients with very early stage HCC. (HEPATOLOGY 2010; 51:1284-1290.)
The role of cytoreduction

**Goldie-Coldman Hypothesis:**
less therapy-resistant clones with a smaller number of cells
- Goldie JH et al., Cancer Res. 1984
- Withers HR et al., Sem Radiat Oncol 2006

**Norton-Simon Hypothesis:**
kinetic resistance - poorer response to chemotherapy in small residueals
Norton L et al., Cancer Treat Rep 1986, Oncologist 2005
Deepness of response

- Lethal tumor load
- Baseline tumor load
- No tumor shrinkage
- Tumor shrinkage

Δ OS

PFS

Δ PFS

Treatment Time

Mansmann UR, et al. ASCO GI 2013 (Abstract no. 427)
Overall Survival

152 Patients, < 10 Metastasis, size < 4 cm, no EHT

Median (95% CI) (Months)
- Systemic: 40.54 (27.50, 47.67)
- RF+Systemic: 45.60 (30.32, 67.75)

8-year OS (95% CI)
- Systemic: 8.9% (3.3, 18.1)
- RF+Systemic: 35.9% (23.8, 48.2)

HR = 0.58, 95% CI (0.38-0.88), p = 0.010 (Log-rank test)

Ruers et al., Ann Oncol 2012
ESMO Guidelines CRC 2016

Figure 1. Toolbox of ablative treatments. SIRT, selective internal radiation therapy; RT, radiation therapy; TACE, transarterial chemoembolisation.