Thermoablation – where do we stand?

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Disclosure

Speaker name: Thomas Vogl

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: travel grant

- I do not have any potential conflict of interest
Liver Malignancies: Check List

1. Unilobar – bilobar
2. Resectable – unresectable
   - resection combined with contralateral ablation
3. Synchronous – metachronous
4. No extrahepatic manifestation – extrahepatic manifestation
   - peritoneum
   - lymph nodes
   - lung
   - (bone tumors)
5. Symptomatic – asymptomatic
Liver Malignancies: Clinical Classification

**Group 1**
Primarily resectable metastases

**Group 2**
Potentially resectable metastases

**Group 3**
Liver metastases that are unlikely to become resectable

- Symptomatic rapid progression
- Asymptomatic slow progression

**Surgery**
- or
- FOLFOX

**Intensified therapy:**
- FOLFOX + Cet
- FOLFIRI + Cet
- FOLFOXIRI
- CT + Bev ? HAI, TACE

Primary goal:
- QoL, survival time $\uparrow$
- TACE, HAI, SIRT

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Thermal Ablation of Liver and Lung Tumors: Technologies

- Chemical
- Radiation
- Ischemic
- Thermal:  
  - radiofrequency (RFA)
  - microwave (MWA)
  - laser-induced thermotherapy (LITT)
  - cryotherapy
- Irreversible electroporation
- Focused ultrasound (HIFU)
Radiofrequency Ablation

1. RFA is based upon the biophysical interaction of high-frequency alternating current (typically 450–500 kHz) and biological tissue in terms of resistive (frictional) energy loss.

2. Between the active and the reference electrode (or two active electrodes in bipolar systems) an electric field is established which oscillates with RF frequency.

3. Ionic oscillatory agitation induced by this oscillating field results in frictional heat followed by “coagulative” necrosis.
Hepatocellular Carcinoma: RF Ablation

Before RFA

10 mo after RFA

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Microwave Ablation

A microwave antenna is placed directly into the tumor. A microwave generator emits an electromagnetic wave (frequency ~ 2450 MHz) through the exposed, noninsulated portion of the antenna. Electromagnetic microwaves agitate water molecules in the surrounding tissue, producing friction and heat, thus inducing cellular death via coagulation necrosis.
**Effects of Microwave Ablation**

- Heating in the complete penetration depth
- Avoidance of tissue carbonization in the vicinity of the applicator
- No restriction of the distribution of microwave energy to tissue
- Significantly reduced "heat-sink" effect

New Microwave Technology

«ROUNDNESS INDEX»

\[
\frac{\text{Long axis area}}{\text{Short axis area}} = 1
\]

- precise
- predictable

Ablation zone

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Spherical Ablation Zone: Advantages

- Sufficient ablative margin around the entire lesion\(^3,4\)
- Reduced local tumor progression\(^5,6\)
- Fewer complications of thermal damage\(^7\)
- Higher safety due to single antenna use
- Higher treatment predictability and reduced duration
- Improved treatment of lesions > 3 cm in diameter\(^8\)

7. Smolock AR et al, Microwave ablation of hepatic tumors abutting the diaphragm is safe and effective. AJR American journal of roentgenology 2015;204(1):197-203.

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Microwave Ablation: Thermosphere™ Technology

69-year-old patient with a liver metastasis from breast cancer

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A0 Ablation of CRLM using MWA

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## Current Results after n=129 Sessions

<table>
<thead>
<tr>
<th>Technical success</th>
<th>98.4% (127/129)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications:</td>
<td></td>
</tr>
<tr>
<td>minor:</td>
<td>24.8% (32/129)</td>
</tr>
<tr>
<td>major:</td>
<td>20.2% (26/129)</td>
</tr>
<tr>
<td></td>
<td>4.6% (6/129)</td>
</tr>
<tr>
<td>Ablation time [min]</td>
<td>Mean: 7.8 (2.5 - 16.0)</td>
</tr>
<tr>
<td>Sphericity [Deviation from 1.0]</td>
<td>Median: 0.192</td>
</tr>
<tr>
<td>Minimal ablative margin [mm]</td>
<td>Median: 5.8 (mean: 6.7)</td>
</tr>
</tbody>
</table>
Survival Rate: Palliative & Curative

Kaplan-Meier: Survival rate for palliative and curative vs. Survival time [Days]
Barcelona Liver Clinic Classification

HCC

- Very early stage (0)
- Early stage (A)
- Intermediate stage (B)
- Advanced stage (C)
- End stage (D)

Candidate for LTX?

- Yes
  - single lesion
  - portal pressure
    - bilirubin
      - increased
    - concomitant diseases
      - normal
      - No

- No
  - Ablation
  - Resection

Liver transplantation

3 lesions ≤ 3 cm
(1 lesion ≤ 5 cm)

Extrahepatic disease
or complete PVT

- No
- Yes

Sorafenib

Symptomatic treatment


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Hepatocellular Carcinoma: MWA

Before MWA

24 h after MWA

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Hepatocellular Carcinoma: MWA

1-year follow-up (art)

1-year follow-up (ven)

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Results

- **Survival rate:** 92%  
  - group 1 – MW ablation: 96% (24/25 pat.)  
  - group 2 – RF ablation: 88% (22/25 pat.)

- **Mortality rate:** 8%  
  - group 1 – MW ablation: 4% (1/25 pat.)  
  - group 2 – RF ablation: 12% (3/25 pat.)

- **No major complications**

- **Other therapies:**  
  - 12.0% (6/50) patients underwent thermal ablation before participating in this trial  
  - 14.0% (7/50) patients received again thermal ablation in other segments of the liver while being part of this trial
Microwave Ablation

I. Faster ↑

II. Higher intratumoral temperatures ↑

III. More clearly delineated ablation zone ↑

IV. Simultaneous ablation ↑

V. Reduced procedural pain ↓

> RFA
MWA of Lung Neoplasms: Patient Selection

Positive factors

- size < 2-3 cm
- location in the outer third of the lung parenchyma

Negative factors

- size > 3 cm
- adjacent to large blood vessels
- < 1 cm distance from trachea, main bronchus, oesophagus, heart
- close proximity to diaphragm, apex

Gillams, Lees et al, Eur Radiol 2008; 18:672-677

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Metastases from bronchogenic carcinoma

MW ablation

24h post MW ablation

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1 year post MW ablation

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Microwave Ablation of Lung Malignancies: Comparison of Techniques

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thermosphere™ Technology</th>
<th>Conventional LF MWA</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical success</td>
<td>98.6% (70/71)</td>
<td>95.8% (68/71)</td>
<td></td>
</tr>
<tr>
<td>Technical efficacy</td>
<td>97.2% (69/71)</td>
<td>95.8% (68/71)</td>
<td></td>
</tr>
<tr>
<td>Complications:</td>
<td></td>
<td></td>
<td>p=0.182</td>
</tr>
<tr>
<td>▶ minor</td>
<td>16.9% (12/71)</td>
<td>21.1% (15/71)</td>
<td></td>
</tr>
<tr>
<td>▶ major</td>
<td>4.2% (3/71)</td>
<td>9.9% (7/71)</td>
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www.fisi-frankfurt.de
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