7. Balloon-Occluded Transarterial Chemoembolization (B-TACE)
(Masahiro Horikawa, MD and Kentaro Yamada, MD)

Balloon-Occluded Transarterial Chemoembolization (B-TACE)

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Learning Objectives: To learn the concept of the procedure, technique, required devices and, above all, flow dynamics related to balloon occlusion to maximize the potential effect of Balloon-Occluded TACE (B-TACE).

Background:
B-TACE was first reported by Irie et al1). The concept is not just a distal protection, but also creating an artificially wedged condition allowing the combination of forceful injecting and lowering of arterial forward pressure (figure 1)1, 2). Recent retrospective studies have demonstrated its superior lipiodol uptake of HCCs as well as equal to superior local control of the tumors compared to conventional TACE (c-TACE)3-7), however, there are multiple technical tips and pitfalls related to B-TACE procedure, particularly about flow dynamics changes caused by balloon occlusion. Hereby, we will focus on topics as follows:

1. Brief concept of B-TACE, focusing on flow dynamics
2. Literature review
3. Tips and pitfalls of the procedure: all about "Flow Dynamics"!!!
4. Case presentation: again, all about "FLOW DYNAMICS"!!!!
Contents:

1. Brief concept of B-TACE and a characteristic case (figures 1 and 2): see the description of figure 1 and figure legends of figure 2.

Figure 1: Mechanism of B-TACE
Figure 2: A characteristic case of B-TACE

76-year-old male with a 51-mm HCC in segment 6 of the liver treated with B-TACE (arrow: microballoon inflated with contrast). Lipiodol emulsion injection under microballoon occlusion demonstrates dense lipiodol accumulation in the tumor and minimal influx into the normal liver parenchyma or portal vein.
2. Literature review (figures 3): series of retrospective studies have demonstrated equal to superior local controls.

**B-TACE: Local control within 1-4M**

<table>
<thead>
<tr>
<th>(3) Asayama</th>
<th>(4) Maruyama</th>
<th>(5) Arai H</th>
<th>(6) Irie</th>
<th>(7) Ogawa</th>
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<tbody>
<tr>
<td>Pt No.</td>
<td>29</td>
<td>50</td>
<td>49</td>
<td>28</td>
</tr>
<tr>
<td>Lesion No.</td>
<td>35</td>
<td>50</td>
<td>49</td>
<td>36</td>
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<tr>
<td>Tumor size</td>
<td>1.7 cm (≤4 cm)</td>
<td>3.2 cm (1-12 cm)</td>
<td>2.9 cm (0.8-7.3 cm)</td>
<td>3.9 cm (1.5-11.3 cm)</td>
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<tr>
<td>Primary or Recurrent</td>
<td>Both</td>
<td>Both</td>
<td>N/A</td>
<td>Primary</td>
</tr>
<tr>
<td>CR (TE4)</td>
<td>&lt;20%</td>
<td>≃ 90%</td>
<td>55.1%</td>
<td>89.3%</td>
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<tr>
<td>c-TACE (TE4)</td>
<td>N/A</td>
<td>≃ 90%</td>
<td>39.6% (p&lt;0.05)</td>
<td>65.3% (p=0.016)</td>
</tr>
</tbody>
</table>

*Equal to superior local control by series of retrospective studies*

*Figure, by courtesy of Dr. Yamakado*

*Figure 3: Summary of retrospective studies of B-TACE*
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3. Tips and pitfalls of the procedure (figures 4 and 5): all about “Flow Dynamics”!! See the description of the figure.

![Figure 4: Pitfall of B-TACE based on its flow dynamics changes](image)

![Figure 5: Types of flow dynamics and their therapeutic effect (1-4M after B-TACE)](image)

<table>
<thead>
<tr>
<th></th>
<th>Poor (TE1/2)</th>
<th>Good (TE3/4)</th>
<th>P value</th>
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<tr>
<td>Type A</td>
<td>5</td>
<td>5 (50%)</td>
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</tr>
<tr>
<td>Type B</td>
<td>2</td>
<td>8 (80%)</td>
<td></td>
</tr>
<tr>
<td>Type C</td>
<td>13</td>
<td>2 (13.3%)</td>
<td>0.003</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>15 (42.9%)</td>
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Figure 5: Types of flow dynamics and their therapeutic effect 3)
4. Case presentation: a couple of cases will be presented to better understand follow dynamics. Again, it's all about "FLOW DYNAMICS"!!!!

Take home messages:
A. Principle 1: Balloon occlusion results in lowering arterial pressure; changes of flow dynamics are presumable by anatomical analysis, particularly by careful interpretation of communicating arteries and negative flows on angiogram. Pressure measurement and/or guiding catheter injection during the occlusion may be helpful for understanding of the changes of flow dynamics.
B. Principle 2: The significance of the B-TACE may be based on lowering the arterial forward pressure rather than "forceful high pressure injection". The lowered pressure gradient between arterial pressure and portal vein pressure may play a key role in effectiveness of B-TACE although the theory has not been shown clearly. Of note a normal parenchyma does have portal vein supply while an HCC in general doesn't.
C. Major issue 1: Balance between embolization area and potential parenchymal damage, which is also related to multiple factors (e.g. tumor characteristics, vascularity, chemo agents/dose, endpoint of the injection, timing and amount of particles).
D. Major issue 2: "Chemical segmentectomy" appears the best indication for B-TACE, however, which may limit the indication of the B-TACE eventually.

Conclusion: The B-TACE procedure has been emerged as a promising method for better control of HCC with less procedural complexities, however, it turns out to be requiring more precise analysis and understanding of flow dynamics of the liver. Scientifically, further investigation is warranted, particularly with prospective studies in comparison to c-TACE.

References:
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Special thanks to Drs. Toshiyuki Irie (Mito Kyodo General Hospital) and Kouichiro Yamakado (Hyogo College of Medicine) for providing important resources for this lecture.