Portal vein embolization:

Venous embolisation before liver surgery: Technical aspects

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- Ewimed
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- Merck
- 3M
- Beacon Bioscience/ICON
- IPSEN
- Bayer
- Pfizer
- Elsai
- MSD
Learning objectives:

1. Access site
2. Segment 4
3. Embolization material
4. Endpoint
Access

Ipsilateral (right)
• no puncture of FLR or mets (compl. ↓)
• catheterisation of seg. 4 branches easier
• more difficult access site for glue
• completion angiography more difficult if glue, coils or plugs are used

Contralateral (left)
• physiologic puncture
• no puncture of tumor-bearing liver lobe
• good for glue embolization
• completion angiography easy
• higher risk of puncture related complications for FLR

Transileocolic
• intra-operative PVE

Transjugular-Transhepatic
• PVE analogous to TIPS-Prozedur

Transsplenic
• PVE after percutaneous spleen puncture
### Portal Vein Variants

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal</strong></td>
<td>Right and left portal vein (RPV, LPV), division of RPV in RAS and RPS</td>
</tr>
<tr>
<td><strong>Type I</strong></td>
<td>Absent LPV, branch from RPV crosses umbilical fissure and supplies left liver</td>
</tr>
<tr>
<td><strong>Type II</strong></td>
<td>Absent RPV, trifurcation in RAS, RPS and LPV</td>
</tr>
<tr>
<td><strong>Type III</strong></td>
<td>RAS (supplying seg. V &amp; VIII) originates from LPV</td>
</tr>
<tr>
<td><strong>Type IV</strong></td>
<td>RPS arises from main portal vein (MPV) before its bifurcation</td>
</tr>
<tr>
<td><strong>Type V</strong></td>
<td>Absent RPV, RPS and RAS. Right liver is supplied by left portal branches</td>
</tr>
</tbody>
</table>

MPV: main portal vein; RPV: right portal vein; LPV: left portal vein; RPS: right posterior segment; RAS: right anterior segment
Embolisation material

- optimal agent:
  - permanent embolization
  - no recanalization
  - well tolerated
  - easy and safe to administer
  - price

- particles
- ethanol
- glue
- gelfoam
- fibrin glue
### Embolisation material

- FLR volume change following right PVE

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Embolic agent</th>
<th>N (Patients)</th>
<th>FLR change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBCA</td>
<td>NBCA</td>
<td>107</td>
<td>58%</td>
</tr>
<tr>
<td>De Baere-T Ann Surg Oncol 2010</td>
<td>NBCA</td>
<td>107</td>
<td>58%</td>
</tr>
<tr>
<td>Azoulay-D, Ann Surg 2000</td>
<td>NBCA</td>
<td>30</td>
<td>46%</td>
</tr>
<tr>
<td>Giraudo-G, Surgery 2008</td>
<td>NBCA</td>
<td>146</td>
<td>42%</td>
</tr>
<tr>
<td>Sirichindakul-B, Hepatogastroenterolog 2007</td>
<td>NBCA</td>
<td>29</td>
<td>28%</td>
</tr>
<tr>
<td><strong>Particles only</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covey-AM, Ann Surg 2005</td>
<td>PVA</td>
<td>39</td>
<td>24%</td>
</tr>
<tr>
<td>Geisel-D, CVIR 2014</td>
<td>PVA</td>
<td>40</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Particles &amp; coil/Plug</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geisel-D, CVIR 2014</td>
<td>PVA &amp; coil/plug</td>
<td>35</td>
<td>53%</td>
</tr>
<tr>
<td>Camelo-R, J Oncol 2019</td>
<td>PVE &amp; coil</td>
<td>64</td>
<td>35%</td>
</tr>
<tr>
<td>Madoff-D, 2003</td>
<td>PVA &amp; coil</td>
<td>26</td>
<td>41%</td>
</tr>
<tr>
<td><strong>Ethanol</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ji-W, World J Gastroenterol 2003</td>
<td>Ethanol</td>
<td>47</td>
<td>27%</td>
</tr>
<tr>
<td>Tsurusaki-M, Br J Radiol 2018</td>
<td>Ethanol</td>
<td>19</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Gelatin sponge</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imamura-H, Hepatology 1991</td>
<td>Gelatin sponge</td>
<td>84</td>
<td>31%</td>
</tr>
</tbody>
</table>

FLR: future liver remnant  
TELV: total estimated liver volume  

\[ \text{TELV} = (\text{total liver volume} - 706,2) \times \text{body surface area} + 2,4 \]
Results

<table>
<thead>
<tr>
<th></th>
<th>Particles only</th>
<th>+ Plug/Coil</th>
</tr>
</thead>
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<tr>
<td>Percentage volume of FLR</td>
<td>30.1 ± 28.8 %</td>
<td>53.3 ± 34.5 %</td>
</tr>
<tr>
<td>Percentage gain of FLR ratio from total liver volume</td>
<td>31.9 ± 26.6 %</td>
<td>49.5 ± 24.2 %</td>
</tr>
</tbody>
</table>

P = 0.003 Geisel D, CVIR 2014

P = 0.004
Charité Berlin: Interventional technique

- US guided puncture of central (right) PV with 22 G Ciba needle
- 0,018” guide wire, introduction of a COOK NEFF set and exchange to 0,035” steel guide wire
- long brite tip 4F sheath into PV
- portography with DSA in 45° RAO projection
- introduction and configuration of 4F sidewinder I (or II) catheter with 0,038” ID
- fluoroscopy guided embolisation using particles and coils
- selective embolisation of seg. 4 branches only in selected cases
- during sheath withdrawal channel embolisation with fibrin glue
Analogo sedation

- 15 mg Piritramid (Dipidolor®)
- 10 mg Metoclopramid (Paspertin®)
- 1-5 mg Midazolam (Dormicum®)
Transiliocolic (intraoperative) PVE
Single-incision laparoscopic surgery portal vein embolization (SILS-PVE)

Plewe-JM accepted in J Min Acc Surg
PVE with PVA & Plug
Interdisciplinary agreement

 Liver metastasis

 Colangiocarcinoma
 Klatskin’s Tumor

 ➢ distance between Coil/Plug and portal vein bifurcation ≥ 10 mm
Segment 4?
Augmented PVE

- ALPPS: associating liver partition and portal vein ligation for staged hepatectomy
- PVE & arterial embolisation
- PVE & hepatic vein embolisation (deprivation)
- PVE & stem cell injection in FLR
Combination portal and hepatic vein embolization (PVE & HVE)

Non-target Embolization
Summary

• access site (our approach: ipsilateral, transhepatic)
• embolisation material (our approach: PVE and plugs)
• PVE is a relatively safe intervention

SIR quality improvement guidelines
- threshold for PVE related major compl. 6%
- morbidity 11%

- 1088 PVEs
- PVE-related morbidity 2.2%
- PVE-related mortality 0%
Thank you

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