Double Embolization for Rapid Liver Hypertrophy: The Endovascular ALPPS

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Growth of future liver remnant (FLR)

- ↑ Extensive liver surgery in oncology
- Main obstacle: size of FLR
- Portal vein embolization (PVE):
  - Increase FLR by up to 30-50% by diverting flow to FLR
  - Disadvantage: waiting time ≈ 6 weeks
Surgical alternative to PVE: ALPPS

- Goal: faster growth of TLR with ALPPS

**Schritt 1**
- Portalvenenligatur
  + *in situ* split

**1 week**

**Schritt 2**
- >30% of total liver

**Entfernung des deportalisierten Lappens**

**Associating Liver Partition and Portal Vein Ligation for Staged Hepatectomy**

Clavien Ann Surg 2012
IR alternative to ALPPS: double vein embolization (DVE)

- Goal: avoid the high complication rate of ALPPS, but keep the fast growth of FLR
- Simultaneous PVE and embolization of the hepatic vein (HVE):
  → double vein embolization (DVE) or liver venous deprivation
Different techniques of DVE

- Access:
  - (Transhepatic approach to portal vein)
  - Transhepatic or jugular vein approach to hepatic vein (PVE first or second?)

- Embolic agent for hepatic vein:
  - Plug alone
  - Plug plus liquids
Anatomy of hepatic veins

- Many branches up to the confluens into IVC
Central positioning of plug

- Goal: occlusion of all hepatic vein branches

Example from Guiu et al. Eur Radiol 2016; 26:4259–4267
Challenges of hepatic vein embolism

- Flow towards catheter (if jugular vein approach is used)

- Diameter widens centrally (funnel shape)
Plug: Amplatzer type 2 (Abbott)

- Self-expandable nitinol mesh
- Detachable after (re)positioning
- Oversizing by >30%
Transhepatic approach to hepatic vein


- Separate puncture for each hepatic vein
- Glue in addition to plugs for HVE
CT for anatomy

- Assess hepatic veins
Transjugular catheterization

- Difficult if horizontal course
Central positioning of plug

- Roadmap confirmation for plug position
Venography before plug release

- Cave: prolapsing into IVC

repositioning!
CBCT to confirm position

- Distinction between right and middle hepatic vein
Additional hepatic vein embolization

- Embolization of middle and right hepatic vein
Portography after HVE

- ↓ portal vein flow after HVE!
Change of portal vein flow

*initial portogram*  *immediately after HVE*
Change of portal vein flow

after embolization of first portal branch
Embolization to the wrong lobe

- Dangerous change of flow dynamics
Successful surgery despite ....

- Hypertrophy of FLR and planned surgery
PVE first! in DVE

- More peripheral embolization!

PVE first

PVE second
Imaging before and after DVE
Schadde & Binkert. EVTodoy 2018; 17:66-69

- Before DVE
  - MRI 7 days later
Early results for DVE

- DVE is safe: no major complication reported
- DVE allows faster growth of FLR (compared to PVE)
- DVE leads to regional change of hepatic function
DVE: initial experience

- Growth of FLR over time after DVE (n=7)
DVE: Winterthur & Zaragoza
unpublished data

- Comparison between DVE/LVD (n=13) and PVE (n=18)

FLR volume change LVD vs. PVE

![Graph showing FLR volume change for LVD and PVE over days.](image)
DVE: functional improvement of FLR

- 99m Tc-mebrofenin (HIDA): rapidly increased function of FLR after DVE (n=10)
Conclusions

- DVE promising technique:
  - fast growth of FLR (incl. function)
  - few complications
- Suggested technique:
  1. Transhepatic portal vein embolization with liquids
     *more distal embo, less risk for wrong side embo*
  2. Transjugular hepatic vein embolization with plugs
- Next step:
  - prospective multicenter studies
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