Vascular Control
- World Practice -

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My surgical strategy

• Try to make operations simple
  – Safer
  – Easier
  – Faster

• More restrictions of motions and instruments in lap

Make lap hepatectomy simple!!!
Main points of bleeding

• Non-anatomic resection
  Resection plane
  intra-segmental
  Inflow (PV & HA) > outflow
  Pringle maneuver

• Anatomic resection
  Resection plane
  watershed area
  Outflow (HV) > inflow
  Intraabdominal pressure & CVP
Pringle maneuver

• A frequent technique used by most hepatic surgeons
  – A survey in Europe: 71% of hepatic surgeons apply
  – Most frequently used technique

the duration of ischemia \( \propto \) length of hospital stay
complications
liver failure or death
Pringle maneuver

Vascular tourniquet

30~40cm 16Fr chest tube
2mm grasping forcep

Pringle maneuver

Vascular clamp

5mm DeBakey
Chitwood deBakey Clamp
Pringle maneuver using Chitwood
## Pros and cons of each technique

<table>
<thead>
<tr>
<th></th>
<th>Vascular tourniquet</th>
<th>Vascular clamp</th>
<th>Chitwood deBakey Clamp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Difficulty of technique</strong></td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Time consumption</strong></td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Application method</strong></td>
<td>1 trochar port</td>
<td>1 tochar port</td>
<td>3~5mm incision</td>
</tr>
<tr>
<td><strong>Effectiveness of inflow control</strong></td>
<td>+</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>
Methods of hepatectomy

1. Parenchymal dissection first
   - Lin & Tung and Quang (1960’s)
   Transect liver parenchyma → Portal pedicles ligated intrahepatically
   → Less injury to hilar structure
   → More bleeding (no inflow control)

2. Controlled hepatectomy
   - Lortat-Jacob and Robert & Honjo and Araki (1950’s)
   Ligate HA/PV/BD → Anatomic parenchymal transection
   → Less bleeding
**Inflow Control**

• Individual isolation & ligation of PV and HA

**Glissonean approach**

– Glisson’s capsule
  • Wraps the portal vein, hepatic artery and bile duct forming one morphological system
  • any variation in the arteries and bile ducts occurs **under the hilar plate**

– Provided in-depth knowledge of the surgical anatomy of the liver
– Has made different types of hepatectomy possible & easy
Totally laparoscopic donor right hepatectomy

Presented at IHPBA 2016
Difficulty of lap approach during hepatectomy

• Caudal approach & motion restriction

• Individual ligation
  – Time consuming
  – Clip or stapler trafficking

• Controlled hepatectomy by Gilssonean approach
  – Hard to encircle
  – Golden finger®, Endoretract Maxi, 10mm right angle forceps
  – Bleeding from hilar plate
  – Injury to small branches during encircling (bile leakage)

• Possible for experts ...
  .... but not easy for beginners
Less bleeding + safer??
Temporary Inflow Control of the Glisson
“TICGL” Method

• Temporary inflow control of the Glissonean pedicle using bulldog clamp
• Parenchymal dissection after inflow control
• Stapling of whole Glisson under full exposure of pedicle after dissection

WHY?

→ Inflow control during parenchymal dissection
→ Easy to encircle the Glisson pedicle
→ Stapling done under full view of glisson pedicle
→ Allows safe stapling without injury to HV, remnant Glisson, small adjacent branches

Lee, Ann Surg Treat Res. 2017
Tips & Tricks

• Dissect with blunt forceps & suction tip
• Bipolar coagulation
TICGL method in HCC with cirrhosis

**Tips & Tricks**

- Expect more bleeding
  → They can almost always be controlled
Stapling during TICGL method

Tips & Tricks

- Contralateral retraction!!!
- Wait 15sec before stapling
- Check thickness
  White (2.5mm)
  Tan (2.5-3.5)
  Blue (3.5)
- 45cm length
Application of TICGL method

• It may be used for various anatomic liver resections
  – Post PVE right sided hepatectomy
  – Right anterior sectionectomy → RA Glisson branch
  – Right posterior sectionectomy → RP Glisson branch
  – Left hepatectomy → Left Glisson branch
  – Monosegmentectomy → corresponding Glisson branch

→ Use the bulldog whenever necessary!!
TICGL in Left Hepatectomy

Tips & Tricks

• Long HA/PV → easy individual ligation

• Staple after right anterior branch is verified
**TICGL in Rt Ant Sectionectomy or Central Bisectionectomy**

**Tips & Tricks**

- Deep branching type
  - Central hepatectomy
    Transect S4 / S5&8 plane first
  - Right anterior sectionectomy
    TICGL (15min interval) right pedicle first
    TICGL right posterior branch

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Laparoscopic right anterior sectionectomy

by The Glissonian approach using the temporary inflow control of Glissonian pedicle (TICGL) technique

Choon Hyuck David Kwon
Samsung Medical center
## Right/ExtRt Hepatectomy after PVE

<table>
<thead>
<tr>
<th></th>
<th>Op</th>
<th>Op time (min)</th>
<th>Pringle maneuver (min)</th>
<th>EBL (ml)</th>
<th>Margin (cm)</th>
<th>Stapler color</th>
<th>Complications</th>
<th>LOS (days)</th>
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<tbody>
<tr>
<td>1</td>
<td>eRH</td>
<td>803</td>
<td>3 (45)</td>
<td>&lt; 300</td>
<td>1</td>
<td>white*</td>
<td>postoperative bleeding, bile leak IIIa</td>
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<tr>
<td>2</td>
<td>eRH</td>
<td>293</td>
<td>0</td>
<td>&lt; 100</td>
<td>5.5</td>
<td>tan†</td>
<td>upper limb DVT II</td>
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<tr>
<td>3</td>
<td>RH &amp; RC</td>
<td>324</td>
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<tr>
<td>5</td>
<td>RH</td>
<td>363</td>
<td>1 (8)</td>
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<tr>
<td>6</td>
<td>RH</td>
<td>253</td>
<td>0</td>
<td>&lt; 100</td>
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<td>7</td>
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<td>266</td>
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<tr>
<td>8</td>
<td>RH</td>
<td>246</td>
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<td>RH</td>
<td>332</td>
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<td>RH</td>
<td>570</td>
<td>3 (45)</td>
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<td>brain air embolism V</td>
<td>10</td>
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<tr>
<td>12</td>
<td>eRH</td>
<td>248</td>
<td>2 (30)</td>
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<td>1.4</td>
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<tr>
<td>13</td>
<td>RH</td>
<td>421</td>
<td>5 (75)</td>
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<td>0.5</td>
<td>tan, purple‡</td>
<td>brain air embolism V</td>
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<td>14</td>
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<td>&lt; 300</td>
<td>1</td>
<td>tan, purple‡</td>
<td>brain air embolism V</td>
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<tr>
<td>15</td>
<td>RH</td>
<td>343</td>
<td>0</td>
<td>&lt; 100</td>
<td>1.1</td>
<td>Blue</td>
<td>brain air embolism V</td>
<td>7</td>
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<tr>
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<td></td>
<td>324</td>
<td>1 (30)</td>
<td>&lt;100</td>
<td>1</td>
<td></td>
<td>post-hepatectomy liver insufficiency IVa</td>
<td>9</td>
</tr>
</tbody>
</table>

### Tips & Tricks

- Thicker portal pedicles
- Adhesion & inflammation
- Bleeding tendency

→ Larger / 2x bulldog

Nasser, under review
Complication Rate during TICGL Method

- **Right hepatectomy for HCC (n=59)**
  - 2010.1~2014.12
  - Complication: 6 Gr I/II, 1 Gr III
  - NO PV stenosis, NO biliary stenosis

- **Right hepatectomy after PVE**
  - May 2012 and September 2014
  - 15 cases (11 right, 4 right extended)
    - 1 bile leakage/stricture (7%)
    - White cartilage used without contralateral retraction
# TICGL method in Rt Ant Sectionectomy / Central Bisectionectomy

<table>
<thead>
<tr>
<th></th>
<th>LLR (N = 20)</th>
<th>OLR (N = 86)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital stay, median (range), days</td>
<td>8 (5-24)</td>
<td>11 (5-176)</td>
<td>0.004</td>
</tr>
<tr>
<td>Morbidity (n, %)</td>
<td>6 (30%)</td>
<td>29 (34%)</td>
<td>0.597</td>
</tr>
<tr>
<td>Clavien-Dindo grade (I:II:IIIa:IIIb:IVb)</td>
<td>2:1:3:0:0</td>
<td>15:1:11:1:1</td>
<td>0.685</td>
</tr>
<tr>
<td>Morbidity type (n, %)</td>
<td></td>
<td></td>
<td>0.544</td>
</tr>
<tr>
<td>Bile leakage</td>
<td>3 (15%)</td>
<td>12(14%)</td>
<td></td>
</tr>
<tr>
<td>Partial portal vein thrombosis</td>
<td>1(5%)</td>
<td>1(1%)</td>
<td></td>
</tr>
<tr>
<td>Transient liver failure*</td>
<td>1(5%)</td>
<td>1(1%)</td>
<td></td>
</tr>
<tr>
<td>Liver failure</td>
<td>0</td>
<td>1(1%)</td>
<td></td>
</tr>
<tr>
<td>Wound complication</td>
<td>0</td>
<td>5 (6%)</td>
<td></td>
</tr>
<tr>
<td>Ascites</td>
<td>1 (5%)</td>
<td>9 (11%)</td>
<td></td>
</tr>
<tr>
<td>Reoperation</td>
<td>0 (0%)</td>
<td>2 (2%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Postoperative 90-day mortality</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Transient liver failure are characterized by an increased international normalized ratio and concomitant hyperbilirubinemia (according to the normal limits of the local laboratory) on or after postoperative day 5.

Apr 2011 ~ March 2016

No PV stenosis
No biliary stenosis
**TICGL method in right posterior sectionectomy**

- Laparoscopic versus open *right posterior sectionectomy* for HCC
- January 2009 to August 2016
- 48 patients in LRPS group vs. 74 in ORPS group (1:2 propensity score matching)
- NO PV stenosis, NO biliary stenosis

<table>
<thead>
<tr>
<th></th>
<th>LRPS (n=48)</th>
<th>ORPS (n=74)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (M:F)</td>
<td>40/8</td>
<td>65/9</td>
<td>0.66</td>
</tr>
<tr>
<td>Age</td>
<td>58 ± 8.5</td>
<td>58 ± 9.7</td>
<td>0.97</td>
</tr>
<tr>
<td>Cirrhosis</td>
<td>40%</td>
<td>43%</td>
<td>0.83</td>
</tr>
<tr>
<td>Op time (min)</td>
<td>387 ± 136</td>
<td>223 ± 86</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pringle maneuver</td>
<td>81%</td>
<td>81%</td>
<td>1.00</td>
</tr>
<tr>
<td>Transfusion</td>
<td>12.5%</td>
<td>4.1%</td>
<td>0.17</td>
</tr>
<tr>
<td>Complication</td>
<td>10.4%</td>
<td>8.1%</td>
<td>0.91</td>
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<tr>
<td>CD III/IV/V</td>
<td>1</td>
<td>2</td>
<td>0.64</td>
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<tr>
<td>Comprehensive</td>
<td>17.1 ± 8.0</td>
<td>37.8 ± 33.1</td>
<td>0.21</td>
</tr>
</tbody>
</table>
Different pedicle clamping methods are applicable
  – Vascular torniquet, vascular clamp (inc. Chitwood deBakey)

Glissonean approach using TICGL (temporary inflow control of the glissonean pedicle)
  – Quick and easy
  – Allows less bleeding (inflow control) and safe stapling (full exposure of the pedicle)
  – Applicable to different types of anatomic resections
    • Right, right posterior, right anterior, left, and right side liver after PVE

Precautions
  • Contralateral retraction, appropriate cartilage