Role of ICG-fluorescence imaging in laparoscopic hepatectomy

Takeaki Ishizawa, MD, PhD, FACS
Cancer Institute Hospital, Japanese Foundation for Cancer Research
Current applications of Intraoperative ICG-fluorescence imaging in HPB surgery

1) Fluorescence cholangiography
2) Identification of hepatic malignancies
3) Identification of hepatic segments
Fluorescence cholangiography

Administration of ICG

1) Intrabiliary injection of ICG (0.025 mg/mL)
2) Intravenous injection of ICG (2.5 mg)

Current applications of Intraoperative ICG- fluorescence imaging in HPB surgery

1) Fluorescence cholangiography
2) Identification of hepatic malignancies
3) Identification of hepatic segments
### Fluorescent patterns of HCC

<table>
<thead>
<tr>
<th>Differentiation</th>
<th>n=277</th>
<th>Total</th>
<th>Well</th>
<th>Moderate</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial</td>
<td></td>
<td></td>
<td>Well</td>
<td>9</td>
<td></td>
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<tr>
<td>Rim</td>
<td></td>
<td></td>
<td>Well</td>
<td>1</td>
<td></td>
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</tbody>
</table>

(Non-fluorescing HCCs, n = 3)
Fluorescent patterns of liver metastasis

- All the 55 CRLM showed rim-type fluorescence
HCC with cancerous fluorescence

Rim-type HCC

Ishizawa T. Ann Surg Oncol 2014
Methods of liver cancer imaging

Administration of ICG

- ICG (0.5 mg/kg) was intravenously injected within 2 weeks before surgery as part of a routine liver function test

Intraoperative examination

- Fluorescent images of liver surfaces and resected specimens were obtained using fluorescence imaging system

Ishizawa T. Cancer 2009
Limitations liver cancer imaging

- False positive rate (- 40%)
- Tissue permeability (< 8 mm)

Ishizawa T. Cancer 2009
Fusion ICG-fluorescence imaging

Fusion ICG-fluorescence imaging

Fusion ICG-fluorescence imaging

Fusion ICG-fluorescence imaging

Fusion ICG-fluorescence imaging (n=52)

- 44 tumors (85%) were identified on the liver surfaces prior to hepatectomy
  - (23) -- identifiable by both FI and white-light color imaging
  - (21) -- grossly unidentifiable, visualized by FI
  - (4) -- undetectable by IOUS

Development of imaging systems

Kono Y, Ishizawa T. Medicine 2015
Wedge S4/8 resection for CRLMs
Lap-H (wedge resection of S4/8 for CRLMs)
Lap-H for CRLMs in S4/8
Lap-H for CRLMs in S4/8
Lap-H (wedge resection of S4/8 for CRLMs)
Lap-H (wedge resection of S4/8 for CRLMs)
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Lap-H (wedge resection of S4/8 for CRLMs)

Op. time: 7h 20 min (Lap-LAR+Hx)
Op. time: 4h 12 min (Lap-Hx)
Blood loss: 10 mL
Current applications of Intraoperative ICG-fluorescence imaging in HPB surgery

1) Fluorescence cholangiography
2) Identification of hepatic malignancies
3) Identification of hepatic segments
Identification of hepatic segments (conventional)

Makuuchi M. Surg Gynecol Obstet 1985
Identification of hepatic segments (conventional)

Identification of hepatic segments (ICG, PV)

Inoue Y, Saiura A. Ann Surg 2015

Miyata A, Ishizawa T. JACS 2015
Identification of hepatic segments (Lap)

Ishizawa T, Gayet B. Arch Surg 2012
Identification of hepatic segments (Lap)

Positive staining

Negative staining

Ishizawa T, Gayet B. Arch Surg 2012
Anatomic S3 resection for HCC
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Lap-H (resection of S3 for HCC)
Op. time: 347 min
Blood loss: 330 mL
Lap-left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
Laparoscopic left hepatectomy for HCC
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Laparoscopic left hepatectomy for HCC
Conclusions

- ICG-fluorescence imaging is a simple and easy intraoperative navigation tool enabling visualization of the bile ducts, hepatic tumors and segmentary boundaries during laparoscopic hepatectomy.
Thank you for your attention!

Takeaki ISHIZAWA, take1438@gmail.com