

# Consensus guidelines for the use of fluorescence imaging in hepatobiliary surgery

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## ABSTRACT:

**Objective:** To establish consensus recommendations for the use of fluorescence imaging with indocyanine green (ICG) in hepatobiliary surgery.

**Background:** ICG fluorescence imaging has gained popularity in hepatobiliary surgery in recent years. However, there is varied evidence on the use, dosage and timing of administration of ICG in clinical practice. To standardize the use of this imaging modality in hepatobiliary surgery, a panel of pioneering experts from the Asia-Pacific region sought to establish a set of consensus recommendations by consolidating the available evidence and clinical experiences.

**Methods:** A total of 13 surgeons experienced in hepatobiliary surgery and/or minimally invasive surgery formed an expert consensus panel in Shanghai, China in October 2018. By the modified Delphi method, they presented the relevant evidence, discussed clinical experiences, and derived consensus statements on the use of ICG in hepatobiliary surgery. Each statement was discussed and modified until a unanimous consensus was achieved.

**Results:** A total of seven recommendations for the clinical applications of ICG in hepatobiliary surgery were formulated.

**Conclusions:** The Shanghai consensus recommendations offer practical tips and techniques to augment the safety and technical feasibility of ICG fluorescence-guided hepatobiliary surgery, including laparoscopic cholecystectomy, liver segmentectomy and liver transplantation.

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## Key Points:

1. Publications, including randomized controlled trials, cohort studies, case series/reports and reviews, from 1960 to 2018 regarding ICG-guided surgical techniques were searched for on the PubMed database. 5 articles from 2019 were also included for analysis after the consensus meeting because of their importance and relevance.
2. **Section 1: Fluorescence cholangiography**  
Although it cannot preclude the principles of safe cholecystectomy, fluorescence imaging can help surgeons identify extrahepatic biliary anatomy. In laparoscopic cholecystectomy, fluorescence imaging may illuminate aberrant anatomy and accessory biliary ducts to aid in safe dissection of critical structures.

**Recommendation: Fluorescence imaging is recommended and should be performed for Lap Chole.**

**Level of Evidence: I**

3. Section 2: Tumor Imaging

- a. Fluorescence imaging is helpful to localize subcapsular tumors within 8 mm of the liver surface or cut surface of the liver parenchyma. Despite very high sensitivity, the false-positive rate of fluorescence imaging may be as high as 40%, suggesting that any lesions that are newly identified using the modality be confirmed by further clinical assessments before resection is chosen.

**Recommendation: Fluorescence imaging is reasonable and can be beneficial for localizing subcapsular tumors.**

**Level of Evidence: II-3**

- b. For resection of deep colorectal liver metastases on the cut surface of the liver, guidance of fluorescence imaging may reduce the risk of positive margins.

**Recommendation: Fluorescence imaging might be considered for colorectal liver metastases to reduce the risk of positive margins.**

**Level of Evidence: II-3**

- c. For resection of deep HCC on the cut surface of the liver, guidance of fluorescence imaging may reduce the risk of positive margins.

**Recommendation: Fluorescence imaging is reasonable and can be beneficial for deep HCC to reduce the risk of positive margins.**

**Level of Evidence: II-3**

4. Section 3: Fluorescence-guided anatomical liver resection

- a. Fluorescence imaging is helpful in delineating segmental boundaries for open anatomic liver resection, while the concurrent use of IOUS is required in positive staining.

**Recommendation: Fluorescence imaging is reasonable and can be beneficial for delineating segmental boundaries for open anatomic liver resection.**

**Level of Evidence: II-2**

- b. Fluorescence imaging is helpful in delineating segmental boundaries for minimally invasive liver resection, while the concurrent use of IOUS is required in positive staining.

**Recommendation: Fluorescence imaging might be considered for delineating segmental boundaries for minimally invasive liver resection.**

**Level of Evidence: II-2**

5. Section 4: Use of ICG fluorescence in LDLT

Fluorescence imaging is useful in illuminating the biliary system around the hilar plate and determining the appropriate division point for bile ducts in major hepatectomy, including donor hepatectomy.

**Consensus: Fluorescence imaging might be considered for illuminating the biliary system during living donor liver transplant.**

**Level of Evidence: II-3**

6. Optimal dosing and timing of ICG:

PROCEDURE	DOSE OF ICG	TIMING OF ADMINISTRATION
<b>Lap Chole</b>	0.05mg/kg body weight or 2.5mg ICG IV	30-60min preoperatively
<b>Tumor Imaging</b>	0.5mg/kg body Weight IV	10-14 days before surgery 1-2 days before surgery 0.2mg/kg should be administered.
<b>Anatomic Resection - Negative Staining</b>	2.5mg ICG IV	After ligation of the Glissonian pedicle to the tumor bearing segment
<b>Anatomic Resection - Positive Staining</b>	5ml of ICG at 0.05-0.025mg ICG/ml aqueous solvent	Intraoperatively
<b>LDLT - Biliary Mapping</b>	2.5mg ICG IV	Intraoperatively, 15-30 min before dissecting the hilar plate