Fluorescent Cholangiography Using Indocyanine Green for Laparoscopic Cholecystectomy: An Initial Experience

Intraoperative cholangiography (IOC) is recommended to prevent bile duct injury during laparoscopic cholecystectomy. However, conventional radiographic IOC in a laparoscopic setting is time-consuming, and insertion of a transcystic tube for contrast material injection may in itself cause bile duct injury. Furthermore, conventional IOC exposes the patient and medical staff to radiation and usually requires a large fluoroscopy machine and additional human resources. Recently, we developed a novel fluorescent IOC technique using the intravenous injection of indocyanine green (ICG) to delineate the biliary tract during an open cholecystectomy. Herein, we report our initial experience applying fluorescent IOC to laparoscopic cholecystectomy using a newly devised laparoscopic fluorescent imaging system.

Our fluorescent IOC technique is based on the principle that ICG is excreted into bile and that protein-bound ICG emits light with a peak wavelength of approximately 830 nm when illuminated with near-infrared light. The prototypic fluorescent imaging system (Hamamatsu Photonics Co, Hamamatsu, Japan) is composed of a xenon light source, a small control unit, and a laparoscope (10 mm in diameter) with a charge-coupled device camera, which can filter out light with wavelengths below 810 nm. This imaging system has originally been used for sentinel node biopsies during gastrointestinal surgery.

For editorial comment see page 303

Video available online at www.archsurg.com

We describe the case of a 46-year-old man who underwent laparoscopic cholecystectomy for cholecystolithiasis. One milliliter (2.5 mg/mL) of ICG (Diagnogreen; Daiichi Sankyo Co, Tokyo, Japan) was intravenously injected 2 hours before surgery. The abdominal cavity was insufflated, and a laparoscope was introduced through a subumbilical trocar. After the hepatoduodenal ligament was identified, the color images were changed to fluorescent images using a foot switch. The fluorescing cystic duct and the common hepatic duct were clearly visualized before the dissection of the trigonum cystohepaticum. The cystic duct was isolated and clipped using the fluorescent images to confirm the relationship of the cystic duct to the common hepatic duct. The fluorescence of the biliary tract lasted throughout the laparoscopic procedure (109 minutes).

Fluorescent IOC with intravenous ICG injection has potential advantages over radiographic IOC. First, the technique we described can save time and avoid bile duct injury associated with the insertion of a transcystic tube. Second, it is convenient. Using only a preoperative intravenous ICG injection, surgeons can obtain fluorescent images of the biliary tract at any time, without radiation technicians. Third, fluorescent imaging enables the distinct identification of the biliary tract in relation to surrounding structures and organs, though its ability to detect common bile duct stones remains unclear. Lastly, fluorescent IOC is safe. It does not require irradiation.
and the risk related to the administration of ICG is quite small (approximately 0.003% at doses in excess of 0.5 mg/kg). With further refinements in image resolution, fluorescent IOC may become the optimal tool to confirm biliary tract anatomy for safer laparoscopic cholecystectomy.

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**Author Contributions:** Study concept and design: Ishizawa and Kokudo. Acquisition of data: Ishizawa and Bandai. Analysis and interpretation of data: Ishizawa. Drafting of the manuscript: Ishizawa. Critical revision of the manuscript for important intellectual content: Bandai and Kokudo. Obtained funding: Ishizawa and Kokudo. Administrative, technical, and material support: Bandai. Study supervision: Bandai and Kokudo.

**Financial Disclosure:** None reported.

**Funding/Support:** This work was supported by grants 18790955 and 17591377 from the Ministry of Education, Culture, Sports, Science and Technology of Japan (Dr Kokudo); grant 18230201 from the Scientific Research from the Ministry of Health, Labour, and Welfare of Japan (Dr Kokudo); a grant from the Japanese Society for Advancement of Surgical Techniques (Dr Ishizawa); and a grant from the Japanese Foundation for Research and Promotion of Endoscopy (Dr Ishizawa).

**Additional Information:** The video is available at http://www.archsurg.com.


### COMMENTS AND OPINIONS

#### Sham-Feed or Sham?

We read with interest the meta-analysis by Purkayastha et al on gum chewing and gut function in patients who have undergone colorectal surgery. We performed a similar meta-analysis of randomized controlled trials (RCTs) and recently updated it with an additional RCT. With the use of Comprehensive Meta-Analysis by BioStat (BioStat, Englewood, New Jersey), our updated meta-analysis included 6 RCTs and 256 patients (136 chewing gum; 120 controls). A random-effects model was used owing to significant study heterogeneity, and significant reductions in time to flatus and time to feces were identified, but we did not observe identifiable differences in hospital or postoperative complications as Purkayastha et al did. No complications were associated with gum chewing and only 1 patient failed to tolerate gum owing to ill-fitting dentures. Hence, gum chewing appears to be a very safe and well-tolerated option. However, while we applaud Purkayastha et al for clarifying the evidence base for gum chewing, in our understanding of the existing literature, we would question the value of additional larger studies on gum chewing.

Colorectal resection within an enhanced recovery program has become an accepted standard. Early feeding is a key element in stimulating gut function and reducing metabolic stress. In our meta-analysis, 2 RCTs included laparoscopy but only 1 study used an enhanced recovery program, though the mean times taken to tolerate food in the gum chewing and control groups were 39 hours and 48 hours, respectively. (We would anticipate an earlier dietary intake in the context of an enhanced recovery program.) We propose that early feeding be regarded as the cost-effective option in stimulating gut function with wider benefits to the perioperative patient and that gum chewing may serve a role in patients in whom a prolonged postoperative ileus occurs, a question that has not been answered in any of the included studies.

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**Financial Disclosure:** None reported.


### Asymptomatic Carotid Stenosis: Criterion Standard Should Be Medical Therapy

Both the recent article and accompanying commentary regarding carotid endarterectomy as the criterion standard for revascularization missed the point. Nearly half the patients in the study were asymptomatic. For most of them, revascularization was unwarranted. Transcranial Doppler embolus detection has been shown to identify patients with carotid stenosis who are at higher risk.