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Fluorescent Cholangiography during Laparoscopic Cholecystectomy: Indocyanine Green or New Fluorescent Agents? Letter to the Editor

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To the Editor,

We read with great interest the article by Figueiredo et al. [1], which described fluorescent cholangiography using a new fluorescent agent in mouse models. Congratulations to the authors for developing an imaging system that would enable clear delineation of the extrahepatic bile ducts in real time.

We also have developed fluorescent cholangiography using indocyanine green (ICG) and applied this technique to laparoscopic cholecystectomy in clinical settings [2, 3]. In this technique, 2.5 mg of ICG is intravenously injected before surgery as a fluorescent source, which emits light with a peak wavelength at approximately 830 nm when illuminated with near-infrared light. Intraoperatively, fluorescent images of the biliary tract are obtained with a fluorescent imaging system, comprised of a xenon light source and a laparoscope with a charge-coupled device camera that can filter out light wavelengths below 810 nm. In view of our experience with the ICG-fluorescent cholangiography in more than 50 cases of laparoscopic cholecystectomy [3], we have some concerns about the technique described by Figueiredo et al.

First, the fluorescent agent (VM674) used in their study has absorption/emission peaks at 672/692 nm [1], which are shorter than the corresponding wavelengths for ICG (760/830 nm). In the infrared region, absorption of light by hemoglobin and the light-scattering coefficient decrease with increasing wavelength of the light, which allows better tissue penetration. Thus, the bile duct detectability by fluorescent cholangiography using VM674 is questionable in humans, who have thicker connective tissues around the biliary tract compared with mouse models. Second, the image acquisition time of their imaging system (100 ms per frame) is longer than that of ICG-fluorescent imaging (33 ms per frame), which may significantly affect the fluidity of the fluorescent imaging for clinical use. Finally, the pharmacokinetic characteristics of VM674 remain unclear in humans, although the authors demonstrated in the mouse models that the ratio of the signal intensity of the common bile duct to that of the background liver started to decrease from 25 min after the injection. In contrast, ICG is excreted into the bile beginning a few minutes after it is injected intravenously and the maximum concentration is achieved within 2 h [4], the property that enables ICG-fluorescent imaging to delineate the extrahepatic bile ducts throughout the course of laparoscopic cholecystectomy after a single preoperative injection of ICG [2, 3].

Recently, ICG-fluorescent imaging has been applied not only for cholangiography during cholecystectomy, but also for identifying liver cancers during laparoscopic liver

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resection [5]. Although some instrumental improvements are required to further enhance the quality of ICG-fluorescent imaging of the biliary tracts and liver cancers, we do not feel any urgent need to replace ICG—a clinically available agent—with other fluorescent agents unless a dramatic increase of the signal-to-noise ratio during the fluorescence cholangiography is obtained in large animal models.

References

1. Figueiredo JL, Siegel C, Nahrendorf M et al (2010) Intraoperative near-infrared fluorescent cholangiography (NIRFC) in mouse models of bile duct injury. World J Surg 34:336–343
2. Ishizawa T, Bandai Y, Kokudo N (2009) Fluorescent cholangiography using indocyanine green for laparoscopic cholecystectomy: an initial experience. Arch Surg 144:381–382
3. Ishizawa T, Bandai Y, Ijichi M et al (2010) Fluorescent cholangiography illuminating bile duct anatomy during laparoscopic cholecystectomy. Br J Surg (in press)
4. Cherrick GR, Stein SW, Leevy CM et al (1960) Indocyanine green: observations on its physical properties, plasma decay, and hepatic extraction. J Clin Invest 39:592–600
5. Ishizawa T, Bandai Y, Harada N et al (2010) Indocyanine green-fluorescent imaging of hepatocellular carcinoma during laparoscopic hepatectomy: an initial experience. Asian J Endosc Surg 3:42–45