Indocyanine green fluorescence imaging via endoscopic nasal biliary drainage during laparoscopic deroofing of liver cysts

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INTRODUCTION

Recently, in vivo fluorescence imaging techniques to identify the biological structures during operations have been developed. Among the various candidate fluorophores used in intraoperative imaging, indocyanine green (ICG) has gained widespread acceptance for use in the operative visualisation of the blood flow and lymph nodes.1,2 One of the best indications for intraoperative ICG-based imaging is hepatobiliary surgery because of the ability of ICG to label bile ducts.18 These applications are not only due to the fluorescence of ICG but also due to its property of biliary excretion. However, infusion ICG imaging needs time lag after injection due to moving from bloodstream to bile, and also, additional injection is needed when the fluorescent imaging is not clear.8 In addition, true bile leakage can appear when the intraductal pressure rises rather than intravenous administration. We first applied ICG imaging via 5-Fr endoscopic nasal biliary drainage (ENBD) during laparoscopic deroofing of liver cysts. This technique promptly gives us ICG imaging after ICG injection from ENBD; in addition, direct ICG imaging sometimes reveals minor leakage from sealing line and staple lines; therefore, we believe that direct ICG imaging via ENBD helps us to prevent post-operative bile leakage.

Keywords: Endoscopic nasal biliary drainage, indocyanine green, laparoscopic deroofing, linear stapler, liver cyst

PRE-OPERATIVE PREPARATION

Usual pre-operative work-up examinations such as laboratory data, ICG-R15, X-ray, electrocardiogram and...
respiratory function test reveal eligibility for laparoscopic surgery. Contrast computed tomography (CT) is necessary for clarifying the location of liver cysts and intrahepatic major Glissonean pedicles. Endoscopic retrograde cholangiopancreatography (ERCP) or drip infusion cholangiographic CT is essential to evaluate the intrahepatic biliary tract; however, magnetic resonance cholangiopancreatography is not suitable because of the presence of liver cysts [Figure 1]. We usually perform ERCP on the day before operation and place a 5-Fr ENBD into the common hepatic duct [Figure 2]. When a 5-Fr ENBD tube is inserted into the common bile duct via Vater papilla, endoscopic sphincterotomy is not currently required; therefore, it is seldom that ERCP pancreatitis occurs as a severe complication.

**POSITIONING OF PATIENTS AND PORTS**

The patient is placed in the supine position after the induction of general anaesthesia. Here is a list of all equipment and consumables used during the procedure: laparoscopic ICG fluorescence imaging navigation system (PINPOINT; NOVADAQ Technologies, Canada), routine laparoscopic instruments including atraumatic graspers, scissors and single-use clip appliers, laparoscopic curved and straight tissue sealer (ENSEAL® G2; ETHICON Japan, Japan) and laparoscopic linear staplers (ECHELON FLEX™ GST System; ETHICON Japan, Japan). Port placements are shown in Figure 3.

**OPERATIVE STEPS**

Each patient is placed in a supine position under general anaesthesia, after which the umbilicus is everted. A 1.5-cm skin incision is made through the umbilicus down to the fascia and into the abdominal cavity. A balloon trocar (Kii Balloon Blunt Tip, Applied Medical, United States of America) is installed. Then, another 12-mm trocar and two 5-mm trocars are inserted like as Figure 3.

First, almost intracystic content is removed by suction tube after confirming that the liver cysts do not contain bile. During transecting intrahepatic biliary branches including thicker Glissonean pedicles, ICG (concentration: 2.5 mg/mL) is put into the biliary tract via ENBD [Figure 4a]. Then, the procedure is mainly performed using the normal view mode, and we detect the thin biliary branches using the ICG mode and adjusted the division line of the cystic wall accordingly or occasionally ligate the branches employing clip appliers. However, relatively thick Glissonean pedicle or plural
thin biliary branches are transected by laparoscopic linear staplers [Figure 4b]. During transecting intrahepatic biliary branches including thicker Glissonian pedicles, ICG (concentration: 2.5 mg/mL) is put into the biliary tract via ENBD; ICG imaging mode reveals the not only intrahepatic biliary branches but also unexpected small bile leakages that cannot be identified using the normal view mode. ICG imaging clarifies that even the linear stapler sometimes fails the closure of intrahepatic biliary branches [Figure 4c]. Additional clipping on the stapling line can stop small bile leakage, and re-injection of ICG reveals that the stoppage of bile leakage achieved [Figure 4d]. The resected cystic roof was retrieved and the operation was completed.

**POST-OPERATIVE CARE**

We have to evaluate the intrahepatic biliary tract using any imaging modalities before and after operation because displacement of intrahepatic biliary tracts and intrahepatic cholestasis are often caused by gigantic liver cysts. From these reason, we usually perform ENBD contrast radiography on the post-operative day 1 to confirm the removal of retraction compared to pre-operative condition, if possible, addition of CT is also better [Figure 5a and b]. Then, the patient resumes usual diet and discharges from the hospital. From January 2011 to December 2019, consecutive 29 cases of laparoscopic deroofing of liver cysts have been performed at both Iwate Medical University Hospital and Morioka Municipal Hospital, and we have introduced this technique since 2018 and six cases have undergone this procedure. We have summarised clinical outcome of all six cases of this technique; there have been no perioperative complication in these six cases [Table 1]. From our preliminary results, direct ICG imaging via ENBD during laparoscopic deroofing supplies very clear view of Glissonian pedicles on the cystic wall; therefore, this technique has a potential of application in other hepatobiliary surgeries instead of intravenous ICG injection and transcystic approach.

**Table 1: Patients characteristics and clinical outcome of laparoscopic deroofing employing indocyanine green imaging via endoscopic nasal biliary drainage**

| Variables                                      | n=6         |
|-----------------------------------------------|-------------|
| Age (years)                                   | 66.5 (60-79) |
| Sex (male/female)                             | 0/6         |
| Maximum diameter of liver cysts (cm)          | 23 (20-28)  |
| Complications related to ERCP, n (%)          | 0           |
| Suction volume of cystic content              | 2750 (2200-4000) |
| Operating time (min)                          | 86 (62-120) |
| Blood loss (mL)                                | 8 (3-29)    |
| Intraoperative complication, n (%)            | 0           |
| Resumption of oral intake (days)              | 2 (1-3)     |
| Hospital stay (days)                          | 4 (3-6)     |
| Postoperative complication, n (%)             | 0           |

Median (range). ERCP: Endoscopic retrograde cholangiopancreatography

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**Conflicts of interest**

There are no conflicts of interest.

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