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Laparoscopic cholecystectomy with aberrant bile duct detected by intraoperative fluorescent cholangiography concomitant with angiography: A case report

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ABSTRACT

INTRODUCTION: Laparoscopic cholecystectomy is the standard surgical treatment for patients with benign gallbladder disease. However, bile duct injury continues to be reported as a surgical complication. Intraoperative cholangiography is recommended to reduce the risk of bile duct injury during laparoscopic cholecystectomy. Intraoperative cholangiography using indocyanine green, which is excreted into bile and shows fluorescence under infrared light, has recently been reported as useful in preventing bile duct injury during laparoscopic cholecystectomy. We report here a case of laparoscopic cholecystectomy with an aberrant bile duct detected by intraoperative fluorescent cholangiography concomitant with angiography.

PRESENTATION OF CASE: An 82-year-old woman was diagnosed with cholecystolithiasis and underwent laparoscopic cholecystectomy. An aberrant bile duct branching from the right side of the common hepatic duct was detected by intraoperative indocyanine green fluorescent cholangiography. Furthermore, we were able to confirm the cystic artery by reinjecting indocyanine green during the procedure. Laparoscopic cholecystectomy was performed safely without injuring the aberrant bile duct, despite no recognition of the abnormality on preoperative computed tomography or magnetic resonance imaging.

DISCUSSION AND CONCLUSIONS: Aberrant bile ducts are rare anatomical variation and clinically important because of the susceptibility to injury during cholecystectomy. Our case reported for the first time that fluorescence cholangiography concomitant with angiography was useful for identifying an aberrant bile duct and the cystic artery during laparoscopic cholecystectomy.

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1. Introduction

Laparoscopic cholecystectomy (LC) has become the standard surgical treatment for patients with symptomatic cholecystolithiasis [1,2]. However, bile duct injury continues to be reported as a surgical complication [3]. Bile duct injury is a rare but serious and persistent complication. Intraoperative cholangiography (IOC) is recommended to reduce the risk of bile duct injury during LC [4]. Recently, IOC using indocyanine green (ICG) has been applied clinically, as ICG is excreted into bile and fluoresces under infrared

light [5–9]. We encountered a case of LC with an aberrant bile duct detected by intraoperative fluorescent cholangiography concomitant with angiography. This work is reported in accordance with the SCARE criteria [10].

2. Presentation of case

An 82-year-old woman with a 6-month history of upper abdominal pain after meals had previously been diagnosed with symptomatic cholecystolithiasis. She was referred to our hospital for surgery. On physical examination, abdominal pain on pressure was revealed and blood tests including aspartate aminotransferase, alanine aminotransferase, and bilirubin showed no abnormalities. Contrast-enhanced computed tomography (CT) showed gallbladder stones and revealed no anomalous cystic artery. Magnetic resonance imaging (MRI) revealed no aberrant bile duct (Fig. 1). She underwent LC. First, 1 ml of ICG (2.5 mg/ml, Diagnogreen; Dai-ichi Sankyo, Tokyo, Japan) was intravenously injected 2 h before surgery. Adhesions around the gallbladder were not particularly

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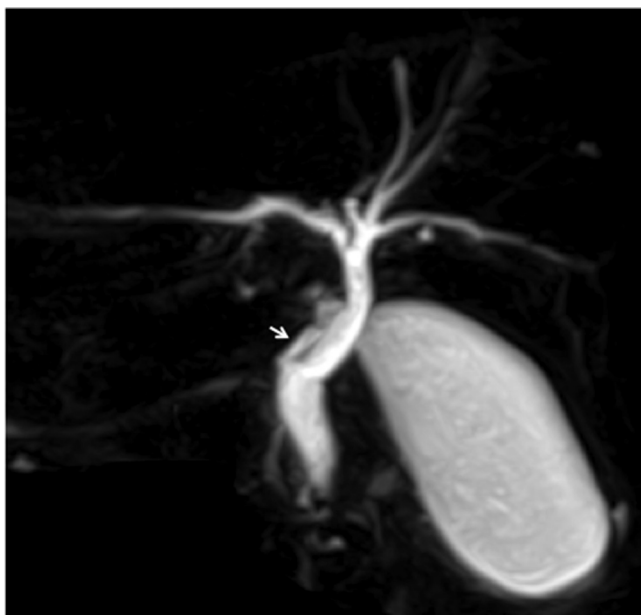


Fig. 1. Preoperative MRI image. The cystic duct is shown (arrow). MRI reveals no anomalous bile duct.

severe, and we were able to safely dissect Calot's triangle. During dissection, we recognized a linear structure posterior to the cystic artery (Fig. 2a). This structure showed fluorescence under near-infrared light, and was considered likely to represent an aberrant

bile duct (Fig. 2b). To confirm the anatomy, we reinjected 2 ml of ICG intravenously during LC and confirmed that the cystic artery showing fluorescence under near-infrared light was located anterior to the identified structure (Fig. 2c). We thus diagnosed the structure as an aberrant bile duct, and LC was completed without injuring this duct (Fig. 3a, b). The patient was discharged on postoperative day 5 without complications.

3. Discussion

LC is a common operation in the field of digestive surgery [3] and offers several advantages over open cholecystectomy, including reduced pain, a lower frequency of wound infection, improved cosmesis, and an earlier return to normal activity. LC is thus a standard surgical treatment for patients with benign gallbladder disease [1,2]. On the other hand, bile duct injury is the most serious surgical complication; although the incidence is a relatively low 0.3–0.5% [3], such injury frequently causes serious conditions such as bile leakage and bile duct stenosis.

IOC is performed to reduce a risk of bile duct injury during LC [4]. However, radiographic IOC during LC is time-consuming, and insertion of a transcystic tube for injection of contrast material may injure the bile duct [11,12]. Furthermore, radiographic IOC exposes the patient and medical staff to radiation and requires additional medical resources. Recently, a novel IOC technique utilizing the fluorescence of ICG excreted in bile after intravenous injection was developed for use in not only open surgery but also laparoscopic surgery [5–9]. ICG is a fluorescent contrast agent with a peak emission of 830 nm when assessed under near-infrared light. Following intravenous injection, ICG binds to plasma proteins and is excreted

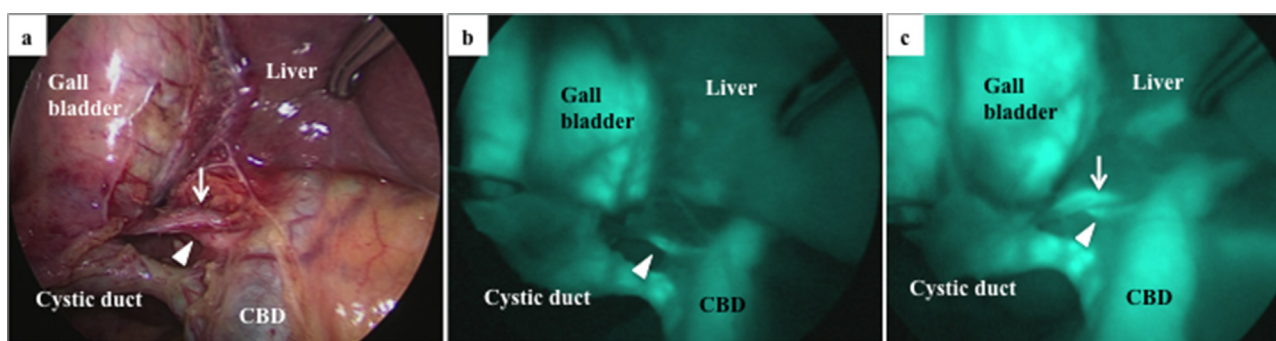


Fig. 2. Findings from Calot's triangle during laparoscopic cholecystectomy. (a) A linear structure (arrowhead) is seen posterior to the cystic artery (arrow) under normal light. (b) The structure thought to represent an aberrant bile duct (arrowhead) shows fluorescence under near-infrared light. (c) The cystic artery (arrow) shows fluorescence under near-infrared light after intravenous injection of 2 ml of ICG during the operation. Posterior to the cystic artery, an aberrant bile duct is evident (arrowhead).

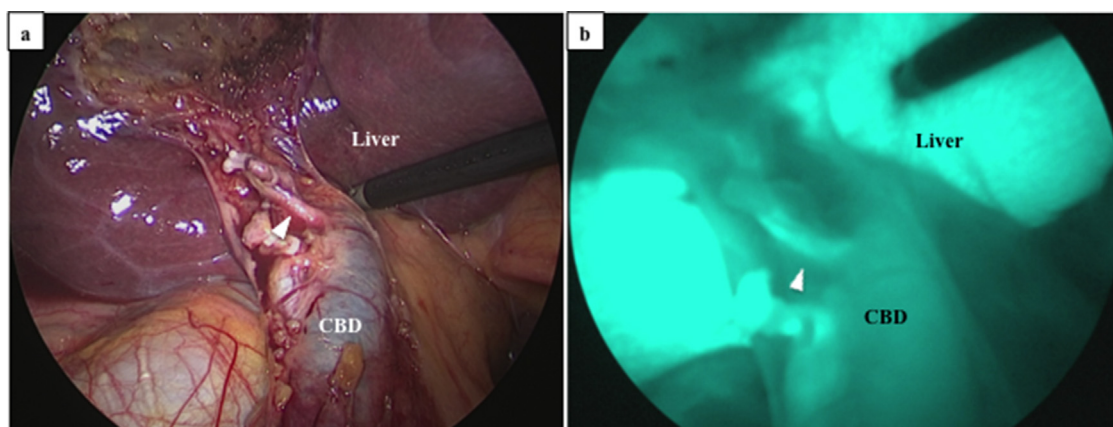


Fig. 3. Findings of the aberrant bile duct after laparoscopic cholecystectomy. (a) The aberrant bile duct (arrowhead) branching from the right side of the common hepatic duct appears well preserved under normal light. (b) The aberrant bile duct (arrowhead) shows fluorescence under near-infrared light.

exclusively by the liver into the bile [13]. The bile duct shows fluorescence under near-infrared light during surgery. Fluorescence cholangiography offers several advantages [8]. The risk of bile duct injury is low, because the bile duct shows fluorescence without peeling off. The fluorescence cholangiography can be used repeatedly by switching on/off. Calot's triangle is then dissected to reach a "critical view of safety", using fluorescence cholangiography to confirm the presence or absence of aberrant bile ducts at any time during the procedure.

In this case, we were able to notice the presence of an aberrant bile duct by fluorescence cholangiography before detachment, although we had not recognized this structure before initiating LC. Furthermore, the cystic artery showed fluorescence under near-infrared light when ICG was intravenously reinjected during the procedure.

Fluorescence angiography was thus also useful for the confirmation of the arterial anatomy, and enabled us to distinguish between the aberrant bile duct and the vessel. Recently, usefulness and safety of combined vascular and biliary fluorescent ICG imaging during LC was reported [14]. Our case reported for the first time that fluorescence cholangiography concomitant with angiography was useful for identifying an aberrant bile duct and the cystic artery during LC.

Aberrant bile ducts are a peculiar anatomical variation, defined as a network of bile ducts located in the peri-hepatic connective tissue of the gallbladder fossa [15,16]. An aberrant hepatic duct draining into the cystic duct is also relatively rare [17]. However, such aberrant bile ducts are clinically important because of the susceptibility to injury during cholecystectomy. Approximately 27% of clinically significant bile leaks reportedly occur from injury to an aberrant bile duct [16]. To avoid injury to an aberrant bile duct, the first priority for surgeons is to be conscious of any abnormal biliary tract and to make efforts to recognize the existence of aberrant bile ducts by preoperative drip infusion cholecystocholangiography-CT or MRCP. Second, unknown linear structures should not be detached before confirmation of the correct anatomy.

4. Conclusion

Fluorescence cholangiography concomitant with angiography was useful for identifying an aberrant bile duct and the cystic artery during laparoscopic cholecystectomy.

Conflicts of Interest

The authors declare that they have no competing interests.

Funding

We declare that none of the authors received external funding for this study.

Ethical approval

The ethical approval has been exempted as it was not necessary in this case report by our institution.

Consent

The patient consented to publication of the features of the case, and the identity of the patient has been protected.

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Author contribution

Y.T. and H.O. participated in the surgery, collected data and consent, and drafted the manuscript. T.S., K.H., K.M., K.A., M.W., and S.M. participated in the surgery. S.N. participated in the design, coordination, and drafting of the manuscript. All authors read and approved the final manuscript.

Registration of research studies

Not applicable.

Guarantor

Hiroshi Okumura.

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