


## CASE REPORT

# Indocyanine green fluorescence: A surgeon's tool for the surgical approach of gallstone ileus

Luis Alejandro Nieto<sup>1</sup> | Luis Felipe Cabrera-Vargas<sup>1,2</sup> |  
Ivan David Lozada-Martínez<sup>2,3,4</sup> | Daniela Guardo-Carmona<sup>2,3</sup> | Martin Contreras<sup>5</sup> |  
Mauricio Pedraza<sup>6</sup> | Alexis Rafael Narvaez-Rojas<sup>7</sup> 

<sup>1</sup>Department of Vascular and Endovascular Surgery, Hospital Militar Central, Universidad Militar Nueva Granada, Bogotá, Colombia

<sup>2</sup>Medical and Surgical Research Center, Future Surgeons Chapter, Colombian Surgery Association, Bogotá, Colombia

<sup>3</sup>Research Unit, Bolivar Chapter, Asociación Colombiana Médica Estudiantil (ACOME), Cartagena, Colombia

<sup>4</sup>Standing Committee on Scientific Evaluation and Development (CPEDEC), Asociación Científica de Estudiantes de Medicina de la Universidad de Santander (ACEMUDES), Bucaramanga, Colombia

<sup>5</sup>Department of Surgery, Hospital San Rafael, Universidad Militar Nueva Granada, Bogotá, Colombia

<sup>6</sup>Department of Surgery, Universidad El Bosque, Bogotá, Colombia

<sup>7</sup>Department of Surgery, Carlos Roberto Huembes Hospital, Universidad Nacional Autónoma de Nicaragua, Managua, Nicaragua

## Correspondence

Alexis Rafael Narvaez-Rojas,  
Department of Surgery, Carlos Roberto  
Huembes Hospital, Universidad  
Nacional Autónoma de Nicaragua,  
Managua, Nicaragua.  
Email: axnarvaez@gmail.com

## Abstract

Fluorescence cholangiography has been shown to improve biliary anatomy identification. A case of 60-year-old man with intestinal obstruction is reported, an entero-biliary fistula is suspected, and intravenous application of indocyanine green is decided, despite the great inflammatory process and fibrotic tissues found during the procedure, safe open cholecystectomy was achieved.

## KEYWORDS

cholecystectomy, fluorescence cholangiography, gallstones, indocyanine green

## 1 | INTRODUCTION

Gallstone ileus is a mechanical obstruction secondary with one or more biliary stones in the small bowel or any part of the gastrointestinal tract; the stone passes through a biliary tract's fistula.<sup>1</sup> This stone obstructs the distal ileum and the ileocecal valve in 50%–75% of the occasions, and just 4% obstructs the outlet gastric tract.<sup>2</sup>

On the contrary, the indocyanine green is an iodized compound.<sup>3,4</sup> It has been used in different applications

since 1950, and it was approved by Food and Drug Administration (FDA) for human use until 1956. As its clearance is hepatic, it allows to effectively visualize, using fluorescence systems, the entire biliary anatomy, thus achieving intraoperative fluorescence cholangiography,<sup>3,5</sup> avoiding the canalization of the cystic duct, and reducing the common bile duct injury.<sup>6</sup>

We present a case of a gallstone ileus patient, where we describe the application of the indocyanine green fluorescence that could help reduce common bile duct injuries and improve the therapeutic of these patients.

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2022 The Authors. *Clinical Case Reports* published by John Wiley & Sons Ltd.

## 2 | CASE PRESENTATION

A 60-year-old man, without any past medical history, arrives in our institution with intestinal obstruction. After the initial treatment for abdominal pain (Figure 1), it was ordered an abdominal computed tomography (CT) where it was observed intestinal dilatation, transition zone in the distal ileum, and pneumobilia suggestive images with extrahepatic duct dilatation (Figure 2).



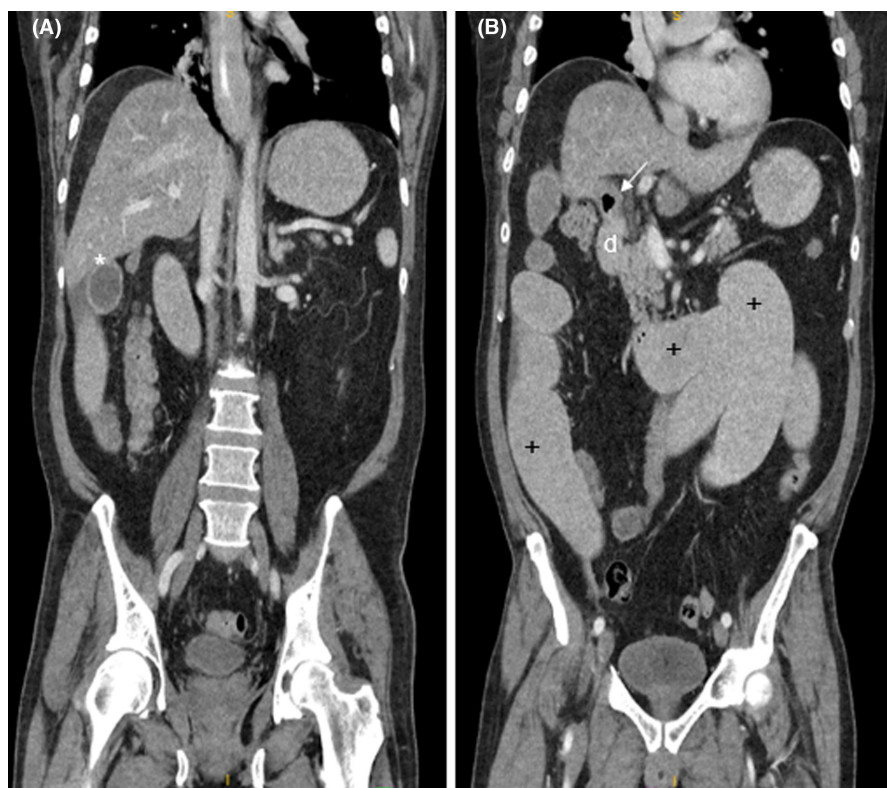
**FIGURE 1** Abdominal X-ray showing dilation of the small bowel loops, without other signs of obstruction. No pneumobilia or ectopic stone is seen

In surgery, was found the obstruction by a biliary stone at 60 cm of the ileocecal valve (Figure 3) and an inflammatory mass with the gallbladder, hepatic angle of the colon, and duodenum in it, identifying a cholecystic-duodenal fistula and a peri-vesicular abscess.

After the extraction of the stone performing an enterotomy, a laparoscopic cholecystectomy was performed, previous 1.5 cc intravenous application of indocyanine green, with which the cystic duct, common hepatic duct, and common bile duct were properly identified, achieving a safe dissection of the structures of the hepatocystic triangle despite the great inflammatory process and fibrotic tissues, and avoiding common bile duct injuries (Figure 4).

## 3 | DISCUSSION

One of the proposed mechanisms for gallstone disease is a biliary tract's fistula secondary to multiple gallbladder inflammatory events and an impacted stone<sup>1,7</sup>; this generates an important inflammatory process; therefore, there is no consensus in the literature which is the best therapeutic approach.<sup>2</sup> A laparotomy with just an enterotomy with stone extraction could generate gallstone ileus recurrences and cholangitis in 33% and 60%,<sup>2,8</sup> and biliary symptoms up to 10%.<sup>1,9</sup> That's why a second approach is to perform a cholecystectomy at the same time or in two steps with similar mortality when we adjust a patient's comorbidities is one or two steps procedure.<sup>1,10</sup>



**FIGURE 2** (A and B) Coronal sections of abdominal tomography with double contrast medium. It is observed (\*) ectopic calculus generating intestinal obstruction with (+) dilation of the small intestine loops. The white arrow indicates the gallbladder with thickened walls, air in its interior and a fistulous path to the duodenum (d)

In 2014, a retrospective review was published considering national databases from the United States, where 3268 cases of gallstone ileus were collected. They found that the fistula's correction is an independent risk factor for mortality, with complications including common bile duct injuries.<sup>11</sup>

To minimize the common bile duct injuries, there are multiple strategies to perform a safe cholecystectomy which are the critical view of safety, intraoperative cholangiography, proposed steps for safe cholecystectomy by different societies, and recently, the use of intraoperative fluorescence cholangiography with indocyanine green. As its clearance is hepatic, it allows to effectively visualize,



FIGURE 3 Transition zone generated by gallstone

using fluorescence systems, the entire biliary anatomy and reduce complications.<sup>3,5</sup>

In a recent meta-analysis, which included 481 patients, the ability to visualize extrahepatic biliary tree structures of usual intraoperative cholangiography was compared to indocyanine green fluorescence cholangiography. They found that fluorescence provided equal visualization of the cystic duct and the junction of the cystic duct with the common hepatic duct when compared with the usual intraoperative cholangiography. However, better visualization of the common hepatic duct was obtained with fluorescence and avoided the canalization of the cystic duct.<sup>12</sup>

Additionally, a meta-analysis was published with studies since 2013, which included a total of 1603 laparoscopic or robotic cholecystectomies with the assistance of fluorescence cholangiography and 5070 patients taken to laparoscopic or robotic cholecystectomy with non-fluorescence cholangiography. A lower rate of common bile duct injuries and conversion to open surgery was found with the fluorescence cholangiography, 6 and 16/10,000, vs. 25 and 271/10,000 with non-fluorescence cholangiography.<sup>13</sup>

Although larger comparative studies are required, preliminary analyses seem to indicate that intraoperative fluorescence cholangiography with indocyanine green markedly decreases the rate of common bile duct injury.<sup>13</sup>

Taking into consideration the risk of common bile duct injuries and the risk of recurrences, but a patient without comorbidities, we decided to perform an open cholecystectomy using fluorescence cholangiography. It was possible to properly identify the common bile duct and the cystic duct to generate an adequate critical view of safety and prevent common bile duct injuries despite the severe inflammatory process. Large studies are needed to

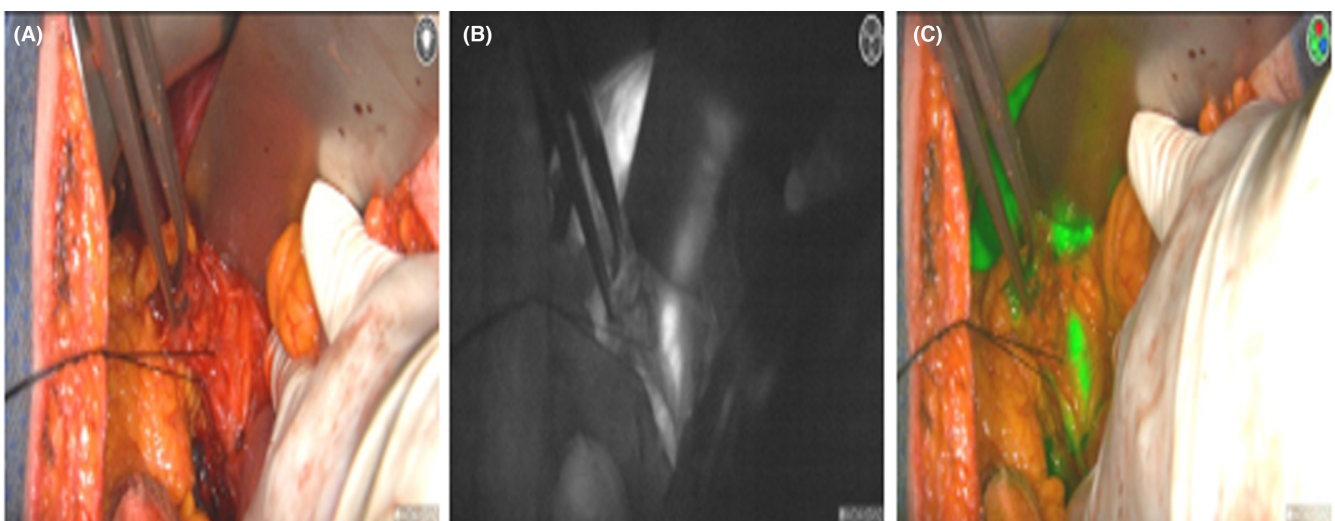


FIGURE 4 (A) Repaired cystic duct is observed, without properly identifying the different structures of the bile duct. (B and C) The extrahepatic bile duct is observed in the different light spectra

demonstrate the benefits of using fluorescence cholangiography that could change the therapeutic in the gallstone disease, and although fluorescence does not replace all the basic principles of a safe cholecystectomy, it does become an important tool to increase the safety of the procedure not only in gallstone disease patients but also in other difficult situations where we can find severe inflammatory processes.

## 4 | CONCLUSIONS

The application of indocyanine green fluorescent could be a useful tool during the surgical management of biliary fistulas and gallstones, focused on improving the visualization of structures and decreasing the risk of injury.

### AUTHOR CONTRIBUTIONS

All authors contributed to the design of this manuscript. LAN and LFCV wrote the first draft. IDLM, DGC, and MC edited and reviewed the final manuscript. MP and ANR scientifically reviewed the article.

### ACKNOWLEDGEMENTS

None.

### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

### DATA AVAILABILITY STATEMENT

Data are available on request from the authors.

### ETHICAL APPROVAL

The authors have confirmed during submission that patient consent has been signed and collected in accordance with the journal's patient consent policy.

### CONSENT

Written informed consent was obtained from the patient to publish this record in accordance with the journal's patient consent policy.

### ORCID

Alexis Rafael Narvaez-Rojas  <https://orcid.org/0000-0001-6987-5030>

## REFERENCES

1. Ploneda-Valencia CF, Gallo-Morales M, Rinchon C, et al. Biliary ileus: a review of the medical literature. *Rev Gastroenterol México*. 2017;82(3):248-254.
2. Alemi F, Seiser N, Ayloo S. Gallstone disease. *Surg Clin N Am*. 2019;99(2):231-244.
3. Reinhart MB, Huntington CR, Blair LJ, Heniford BT, Augenstein VA. Indocyanine green: historical context, current applications, and future considerations. *Surg Innov*. 2016;23(2):166-175.
4. Yannuzzi LA. Indocyanine green angiography: a perspective on use in the clinical setting. *Am J Ophthalmol*. 2011;151(5):745-751.e1.
5. Osayi SN, Wendling MR, Drosdeck JM, et al. Near-infrared fluorescent cholangiography facilitates identification of biliary anatomy during laparoscopic cholecystectomy. *Surg Endosc*. 2015;29(2):368-375.
6. Dip F, Aleman R, Frieder JS, et al. Understanding intraoperative fluorescent cholangiography: ten steps for an effective and successful procedure. *Surg Endosc*. 2021;35(12):7042-7048.
7. Dai X-Z. Gallstone ileus: case report and literature review. *World J Gastroenterol*. 2013;19(33):5586.
8. Wahshaw AL, Bartlett MK. Choice of operation for gallstone intestinal obstruction. *Ann Surg*. 1966;164(6):1051-1055.
9. Martín-Pérez J, Delgado-Plasencia L, Bravo-Gutiérrez A, et al. Biliary ileus as a cause of acute abdomen. Importance of early diagnosis for surgical treatment. *Cir Esp*. 2013;91(8):485-489.
10. Rodríguez-Sanjuán JC, Casado F, Fernández MJ, Morales DJ, Naranjo A. Cholecystectomy and fistula closure versus enterolithotomy alone in gallstone ileus. *Br J Surg*. 1997;84(5):634-637.
11. Halabi WJ, Kang CY, Ketana N, et al. Surgery for gallstone ileus: a nationwide comparison of trends and outcomes. *Ann Surg*. 2014;259(2):329-335.
12. Lim SH, Tan HTA, Shelat VG. Comparison of indocyanine green dye fluorescent cholangiography with intra-operative cholangiography in laparoscopic cholecystectomy: a meta-analysis. *Surg Endosc*. 2021;35(4):1511-1520.
13. Dip F, Lo Menzo E, White KP, Rosenthal RJ. Does near-infrared fluorescent cholangiography with indocyanine green reduce bile duct injuries and conversions to open surgery during laparoscopic or robotic cholecystectomy? — a meta-analysis. *Surgery*. 2021;169(4):859-867.

**How to cite this article:** Nieto LA, Cabrera-Vargas LF, Lozada-Martínez ID, et al. Indocyanine green fluorescence: A surgeon's tool for the surgical approach of gallstone ileus. *Clin Case Rep*. 2022;10:e05873. doi:[10.1002/ccr3.5873](https://doi.org/10.1002/ccr3.5873)