



# **THE IMPACT OF ILLUMINATING TECHNOLOGY in SURGERY**

**UNIT -1/8**

**DEPARTMENT OF GENERAL SURGERY**

**DR DY PATIL MEDICAL COLLEGE AND HOSPITAL, PUNE**

# INTRODUCTION

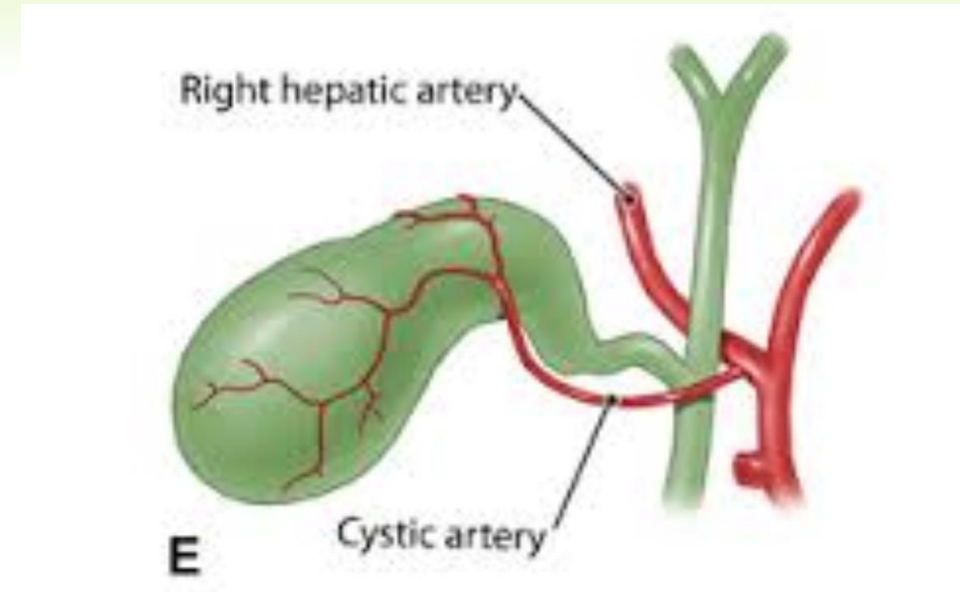
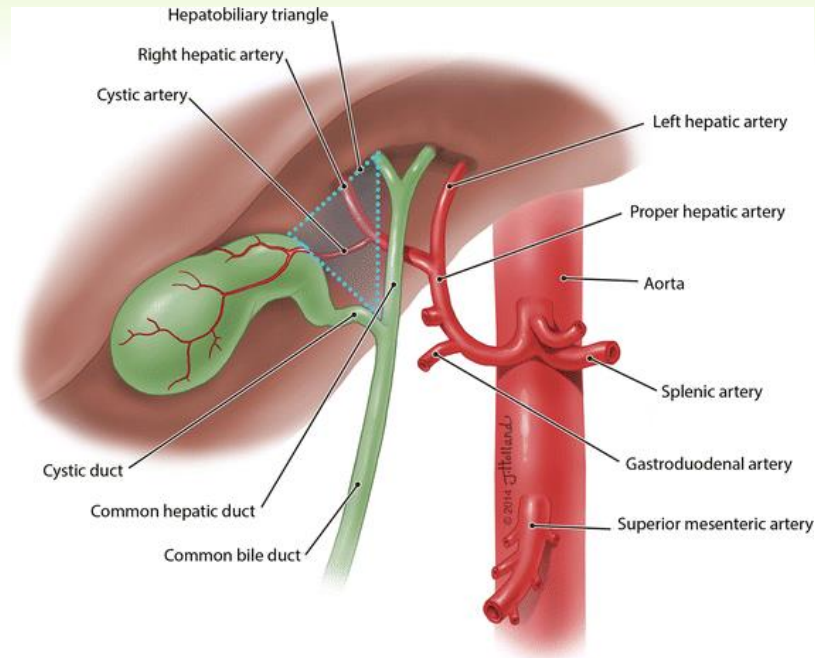
- Laparoscopic Cholecystectomy is one of the most commonly done surgeries for Gallbladder diseases.
- It is a well known fact that there is anatomical variations and congenital anomalies of the biliary tree.
- Due to this, the risk of intraoperative injury to the vascular and biliary system may occur, all-the-more prone in a teaching institution.
- Thus, we discuss how advanced technology helps in reducing morbidity and mortality.

# CASE 1

- 57 year old female, married, residing in Dighi, Pune came in with chief complaint of right sided upper abdominal pain intermittent, non radiating, colicky in nature, aggravated after consumption of food with no relieving factor since 4 days.
- History of nausea (+)
- History of similar complaints on and off since 2 years (3x hospitalised for acute cholecystitis)
- No comorbidities
- H/o Hysterectomy (2007)
- BMI - 25.9 kg/m<sup>2</sup>
- Per abdomen findings: Soft, non tender, no organomegaly, Murphy's sign negative, Bowel sounds present in all quadrants

- **ULTRASONOGRAPHY of Abdomen-pelvis:** Gallbladder is semi-distended and appears normal. A large mobile 19.6 mm echoreflective calculus noted in the GB lumen. No obvious gall bladder wall thickening or pericholecystic collection is noted. CBD is not dilated. Pancreas appears normal in size and echotexture.
- **s/o Cholelithiasis without cholecystitis**

- Plan - Laparoscopic Cholecystectomy with ICG- cholangiogram
- Procedure:
- Intraoperative Findings: Anomalous cystic artery i.e. it was arising from Right Hepatic Artery and anterior to CBD and coursing inferior to Cystic Duct





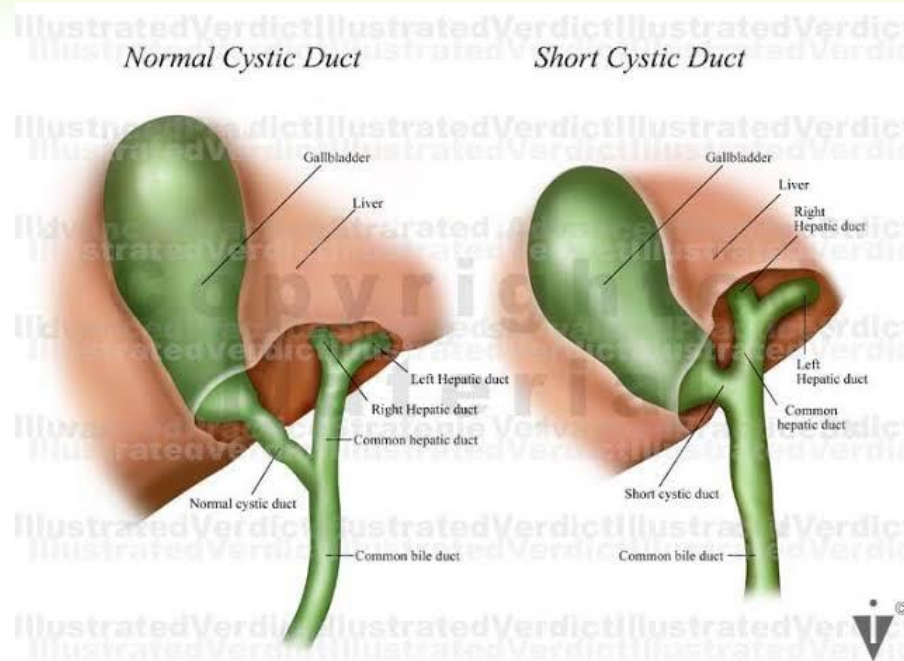
## CASE 2

- 37/F from Pimpri Pune, came with a chief complaint of epigastric pain radiating to right upper abdomen since 1 week, with history of nausea.
- History of similar complaints in last 8 months (admitted 2x for acute cholecystitis)
- No comorbidities
- History of tubectomy 10 years ago
- BMI - 29.8 kg/m<sup>2</sup>
- Per abdomen findings: Soft, non tender, no palpable lump, no organomegaly, Murphy's sign negative, Bowel sounds present in all quadrants

- **ULTRASONOGRAPHY of Abdomen-pelvis:**
- Gall bladder is partially distended with multiple, tiny echoreflexive calculi of average size 3-4 mm in the GB lumen.  
no obvious gall bladder wall thickening or pericholecystic collection is noted. CBD is not dilated. Visualised head and body of pancreas appears normal
- **s/o Cholelithiasis without cholecystitis**



- Plan for Laparoscopic Cholecystectomy with ICG-Cholangiogram was made
- Intraoperative Findings: in this case we encountered a short Cystic Duct,





# CASE 3

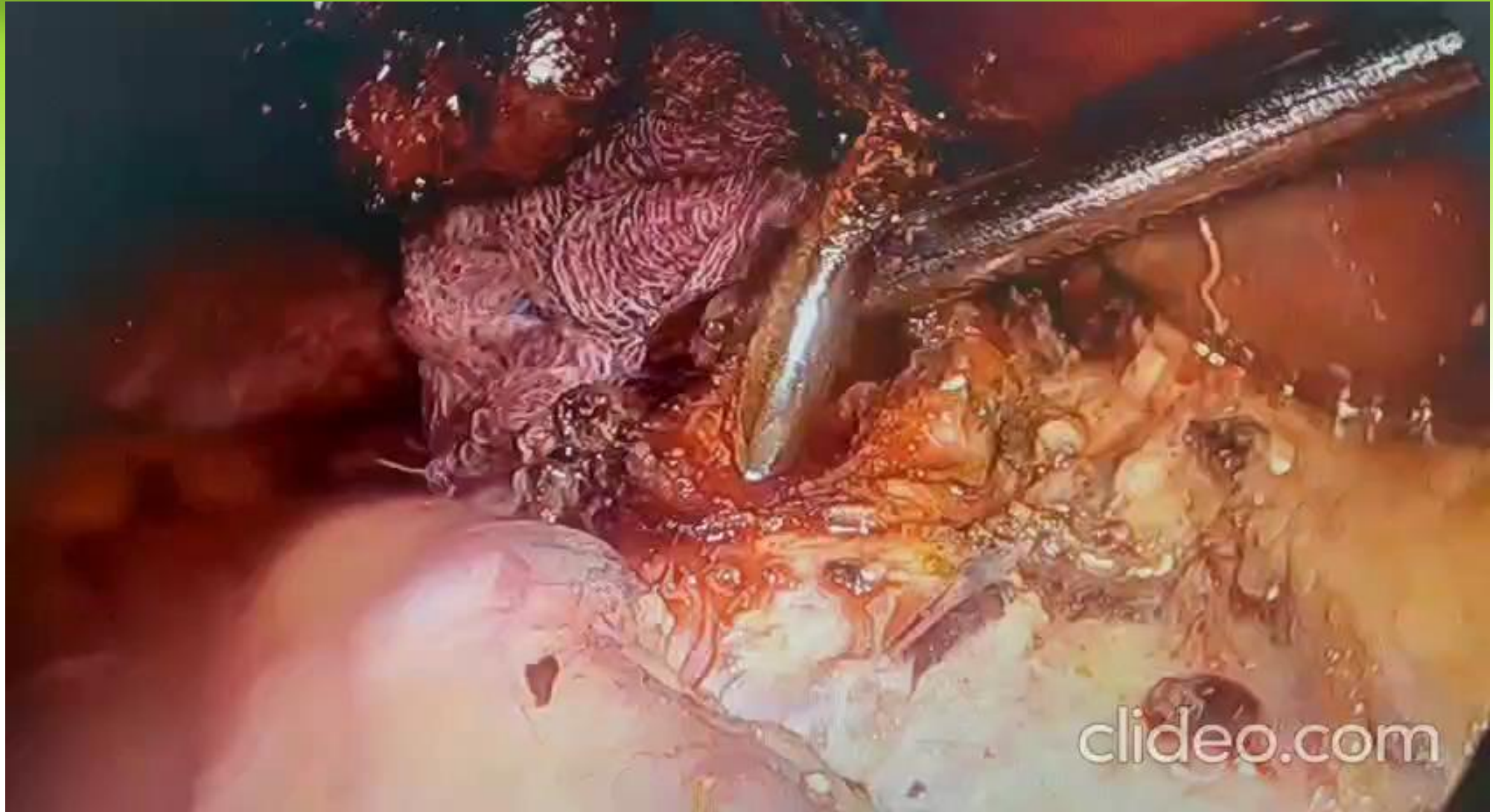
- 35/M from Khadki, pune, came with a chief complaint of epigastrium since 2 months, intermittent, dull aching, with no aggravating or relieving factors, with history of nausea, bloatedness.
- History of similar complaints in last 4 years (admitted 1x for acute cholecystitis with choledocholithiasis in 2021- ERCP stenting done)
- No comorbidities
- BMI - 19.2 kg/m<sup>2</sup>
- Per abdomen findings: Soft, non tender, no palpable lump, no organomegaly, Murphy's sign negative, Bowel sounds present in all quadrants

- **Ultrasonography Abdomen-pelvis:** Liver is normal in size and echotexture with **intrahepatic biliary radicals appear dilated. Gallbladder is distended with multiple echoreflexive calculi of average size 3-4 mm** showing posterior acoustic shadowing. no gall bladder wall thickening or pericholecystic collection noted. Proximal and middle segment of **CBD appears dilated** with maximum transverse diameter measuring 12 mm and shows multiple echoreflexive calculi, largest measuring approx. 21 mm. CBD stent noted in situ.
- **S/O Choledocholithiasis with cholelithiasis without cholecystitis.**

- **MRCP:** Gallbladder is well distended with multiple (7-8) intraluminal filling defects of average size 7 mm are noted in the fundus of the gallbladder. No obvious pericholecystic collection noted. **CHD is grossly dilated** measuring 22 mm with multiple filling defects largest at the confluence measuring 29x22x19 mm. cystic duct appears normal. **CBD is also dilated** measuring 16 mm with multiple filling defects, largest of size 14x313.6 mm in the mid portion. the distal CBD at the ampulla appears normal. **CBD stent is noted in situ** with its proximal end in the RHD. Liver appears normal in size and signal intensity. **IHBR are dilated**, RHD measures 22 mm and LHD measures 20 mm with multiple intraluminal filling defects- multiple tiny calculi in proximal LHD, largest 4x3 mm, calculus of size 8x8 mm in proximal portion of RHD, calculus of 8x3 mm in posterior RHD

- Plan: Laparoscopic CBD exploration with ICG Cholangiogram
- Intraoperative Findings: Dense omental adhesions over the calot's triangle and CBD. ICG facilitated dissection and identification of cystic duct, CBD junction as well as the cystic artery.







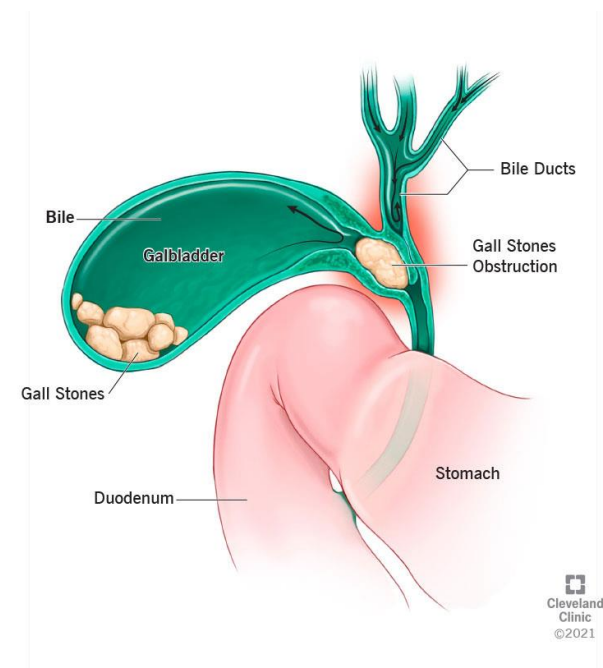


# CASE 4

- 30/M from Bhosari, pune, came with a chief complaint of pain in right upper abdomen since 1 day, intermittent, dull aching, aggravated post meals, with no relieving factors with history of nausea, vomiting and fever.
- No comorbidities
- BMI - 19.6 kg/m<sup>2</sup>
- Per abdomen findings: Soft, tenderness present in right hypochondrium, Murphy's sign positive, Bowel sounds present in all quadrants

- **ULTRASONOGRAPHY of Abdomen-pelvis:**
- Gall bladder is overdistended , marginally edematous with minimal peri-GB free fluid seen. 11-12 mm calculus seen in the GB neck. Distal CBD obscured.
- **s/o Calculous cholecystitis**

- Plan: Emergency Laparoscopic Cholecystectomy with ICG Cholangiogram
- Intraoperative findings: Impacted stone at the neck of the Gallbladder i.e Mucocele GB, making Calots triangle dissection difficult.
- ICG facilitated identification of structures for safe clipping of cystic duct.





# DISCUSSION

- Laparoscopic cholecystectomy (LC), a minimally invasive surgery for removing a diseased gallbladder, was first performed in 1985 by Eric Mühe (Germany).
- It is currently considered the treatment of choice for gallbladder diseases.
- But, according to recent statistics, the common bile duct (CBD) injury rate in Laparoscopic cholecystectomy ranges from 0.1 to 1.5%, generally due to misinterpretation of biliary tract anatomy.

- However, this is a serious complication that has an impact on patients' treatment outcomes and quality of life.
- In hepatobiliary surgery, identifying anatomical features, particularly arteries and the extrahepatic biliary tract variations, is essential to prevent intraoperative complications.

to prevent intraoperative complications

- clear dissection to get a critical view of safety,
- demonstrating the anatomical landmarks of the gallbladder and surrounding organs, and
- Endoscopic ultrasound, intraoperative Cholangiogram and ICG-Cholangiogram



# INDOCYANINE GREEN DYE

- sterile, anionic, water-soluble, tricarboyanine molecule with molecular mass of 776 Daltons
- an inactive, nonradioactive substance that binds to intravascular plasma proteins (especially Lipoproteins) and becomes fluorescent.



- It is subsequently stored in the liver parenchyma and completely excreted in the bile without being metabolized, hence, the extrahepatic biliary tract can be seen by ICG fluorescence imaging
- user-friendly, cost-effective



- The timing of injecting ICG to the patient can be variable, ranging anywhere from 12 hours before surgery to just at induction of anaesthesia.
- The usual dose for standard clinical use (0.1–0.5 mg/ml/kg) is below the toxicity level.

- ICG becomes fluorescent once excited either using a laser beam or by near infra-red (NIR) light at about 820 nm and longer wavelengths, the absorption peak is around 807 nm, and the emission peak is around 822 nm.
- The fluorescence released by ICG can be detected using specifically designated scopes and camera.
- The risk of anaphylaxis with ICG is 0.003% at doses exceeding 0.5 mg/kg.

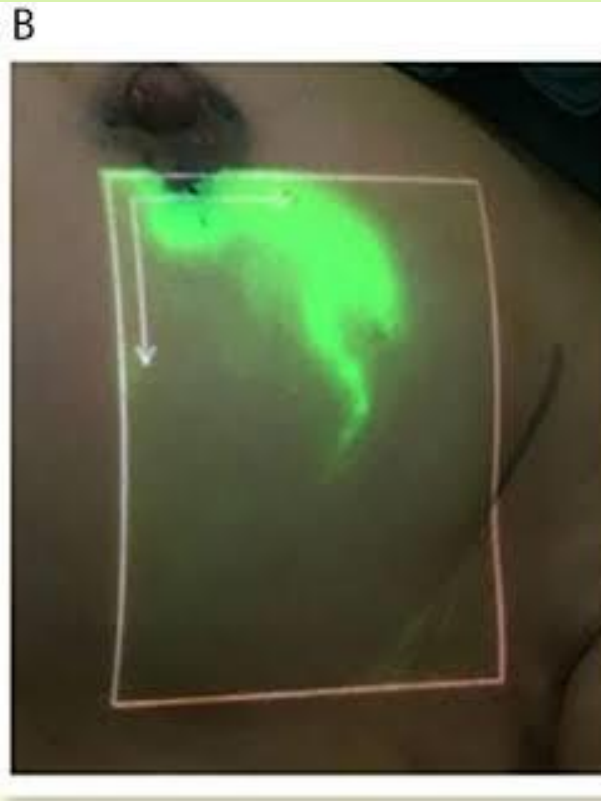
# Preliminary results of laparoscopic cholecystectomy using real-time indocyanine green fluorescence: a cross-sectional study

Van Quang Vu, PhD<sup>a</sup>, Van Thanh Le, PhD<sup>a,\*</sup>, Hoang Ngoc Anh Nguyen, MD<sup>a</sup>, Kim Khue Dang, MD<sup>b</sup>, Mong Vu Anh Luong, MD<sup>b</sup>

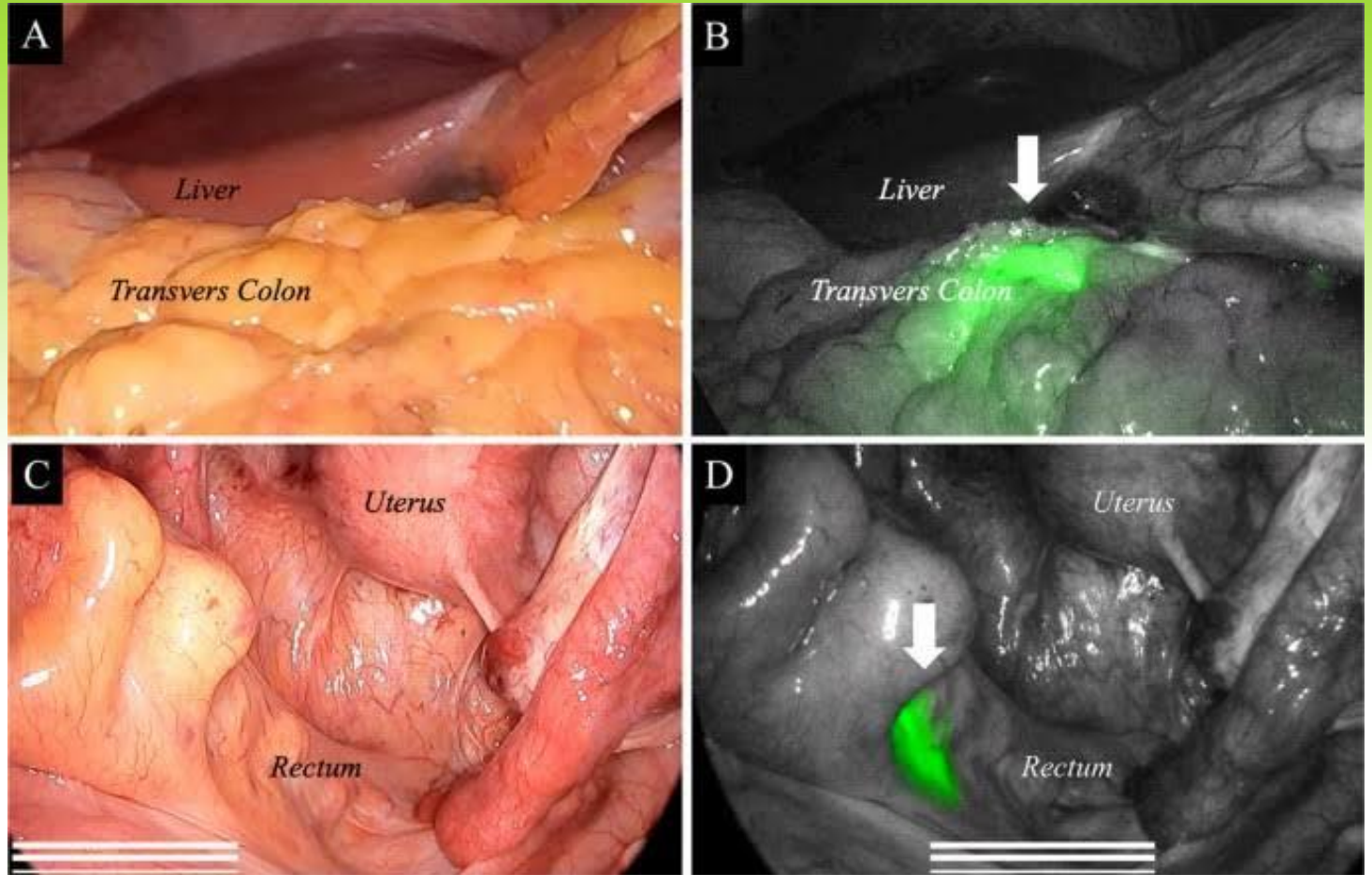
- In the study, 7.35% with abnormal biliary tract variations were identified.
- 2.94% with a low cystic duct
- 1.47% with a segment of tissue that was abnormally thickened and continuous with the gallbladder - an extra bile duct that entered the gallbladder from the liver parenchyma
- 1.47% - left gallbladder bed
- 1.47% - double chambered gallbladder
- The average length of operation was  $42.8 \pm 14.6$  min

## Other uses of INDOCYANINE GREEN

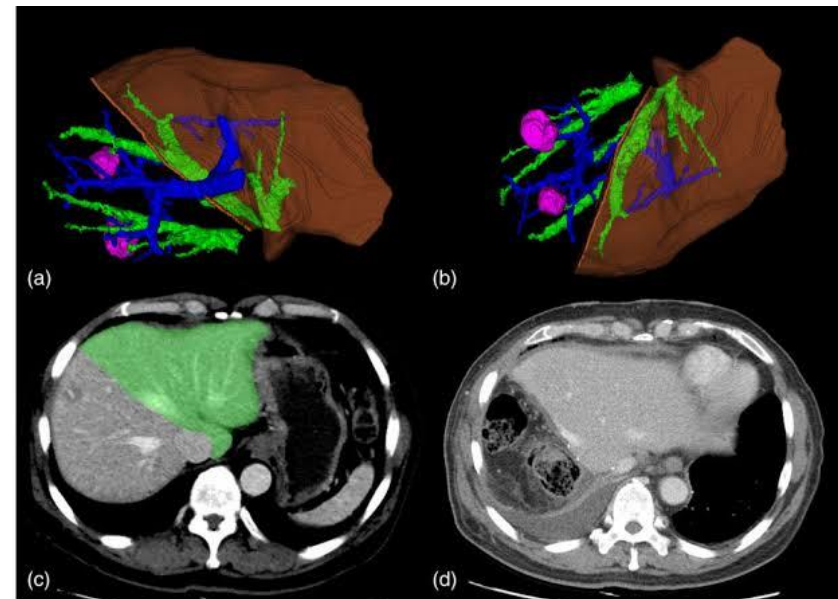
- lymph node dissection for breast cancer, inguinal metastasis



- gastrointestinal cancer  
(to verify the adequate  
perfusion of the large  
bowel prior to  
anastomosis)



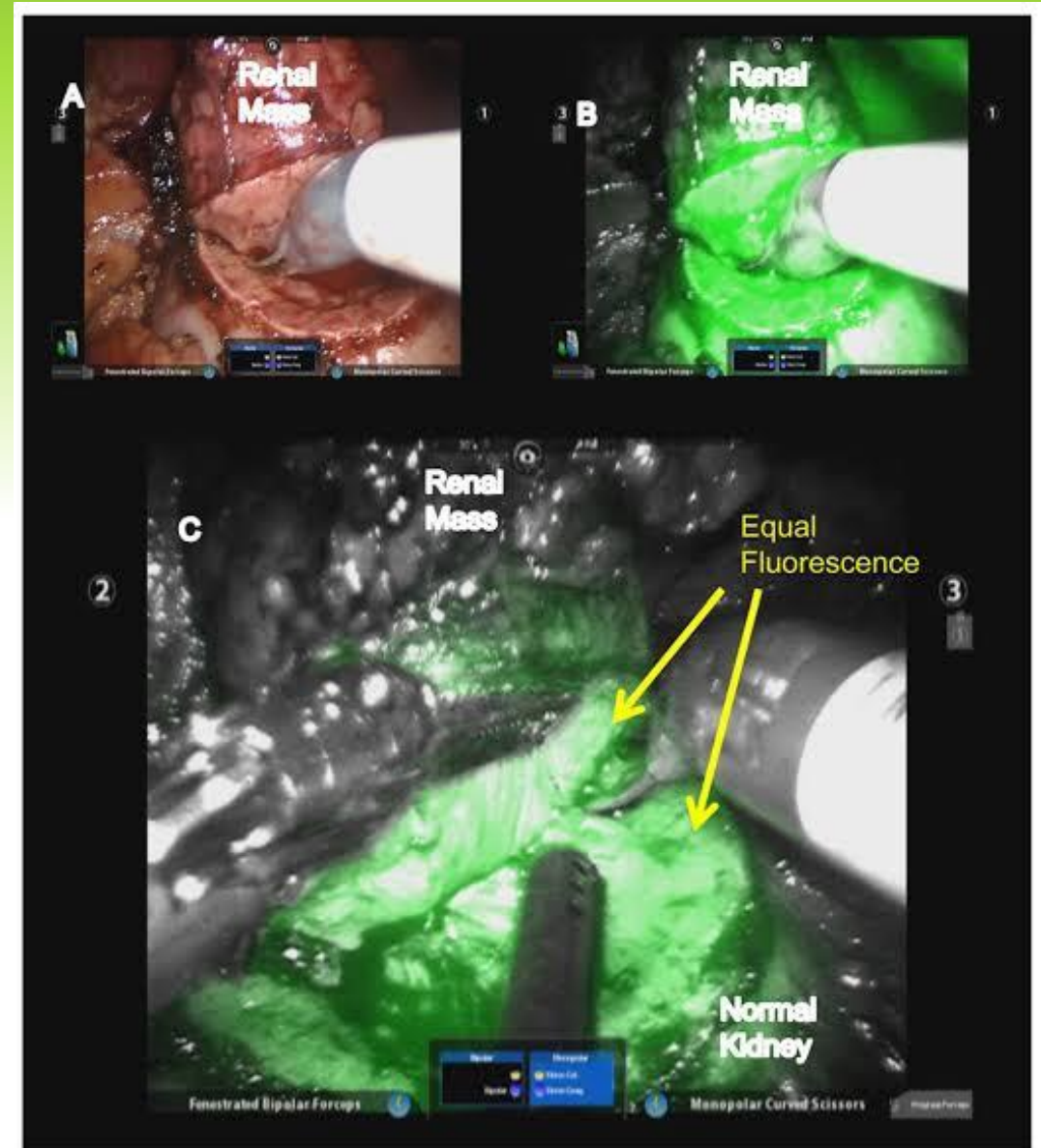
- cholangiography,
- hepatectomy (to measure liver functional reserve before resection)
- liver transplantation
- to measure cardiac output



resection of liver using Dr Liver. The transection line of the virtual liver resection followed the mid-



- to clarify the vascular anatomy during laparoscopic living-donor nephrectomy and laparoscopic kidney autotransplantation for renal artery aneurysm, liver resection, splenectomy, and laparoscopic ligation of the inferior mesenteric artery of type II endo-leak after endovascular repair of aortic aneurysm.



# ADVANTAGES OF ICG-CHOLANGIOGRAPHY

- the handheld equipment's compact size,
- lightweight,
- cost-effectiveness,
- ease of switching between imaging modalities,
- the length of the operation
- No exposure to radiation

# CONCLUSION

ICG cholangiogram is

- user-friendly,
- cost-effective
- novel technique for surgeons during emergency or elective procedures,
- minimises complications and operative time (due to early identification of anatomical variations and anomalies)
- for better visualisation and understanding of anatomical structures in teaching institutions.

# REFERENCES

- Van Quang Vu, PhD, et al, Preliminary results of laparoscopic cholecystectomy using real-time indocyanine green fluorescence: a cross-sectional study, *Annals of Medicine & Surgery* (2023)
- Nicola de' Angelis, et al, 2020 WSES guidelines for the detection and management of bile duct injury during cholecystectomy
- Luigi Boni et al, Clinical applications of indocyanine green (ICG) enhanced fluorescence in laparoscopic surgery, Minimally Invasive Surgery Research Center, Department of Surgical and Morphological Sciences, University of Insubria, Varese, Italy



THANK YOU