Use of Indocyanine Green Dye to Enhance Imagining and Make Informed Surgical Decisions
Gurpreet Singh Malhi, Grozdena Yilmaz, MPA, PA-C

Introduction
Indocyanine Green (ICG) is a dye that is used in clinical settings to augment the imaging such as X-ray and fluoroscopy. ICG is administered intravenously a few minutes before the surgery. Due to its hydrophobic and anionic nature, absorption by the tissue is high. ICG can be excited by a varying wavelength of infrared light depending on the concentration from anywhere between 600 – 900nm and as a result, it can appear as “glowing in dark.” The extent to which specific location illuminates green can show normal or abnormal tissue depending on the type of procedure being performed.

Case Presentation
24 y/o female presents to the ED with epigastric and right upper quadrant pain for the past 6 months. Patient states that the pain exacerbated when she ate fatty foods. Patient denied fever and jaundice.

- Past Medical History: (+) Asthma
- Past Surgical History: (+) Appendectomy
- Medications: None
- Normal Labs
- Physical Exam: No significant findings

Radiographic Studies
Right Upper Quadrant ultrasound was performed which indicated decompressed gall bladder 7.4 x 1.4 x 1.4 cm.

• Multiple stones.
• No sign of cholecystitis (normal gall bladder finding)

Surgical Intervention
Patient scheduled for an elective laparoscopic cholecystectomy.
Cholecystectomy: is the surgical removal of the gall bladder. Although a common procedure, the intertwined anatomy with hepatic system makes it complicated. In a retrospective case study analysis it was found that out the mortality rate went up from 0.3% to 1.6% in patients who had a concomitant common bile duct exploration. Without fluorescent labeling common bile duct is sometimes mistaken for cystic duct which increases the risk of bile duct injuries.

Intraoperative Imaging
This was unique case of duplicated gall-bladder with an incidence of 1:4000 patients. Once identified both gall bladders need to be removed to minimize intra or post complications. The surgical intervention becomes complicated in such cases as there are multiple structures that need to be incised while making sure there is no damage to the hepatobiliary system.

\[ \text{ICG} \text{ dye} \text{ administered} \text{ via} \text{ intravenous} \text{ within} \text{ few} \text{ minutes} \text{ before} \text{ surgery} \]

Intraoperative Cholangiogram was used to address any complications. This is a gold standard procedure which reveals any obstruction due to gall stones and ensure the movement of bile is unobstructed. No obstruction was observed, and bile passed to the duodenum when viewed with the fluorescent.

Discussion
Bile duct injury is the most feared complication during laparoscopic cholecystectomy. In a prospective analysis of 44 patients undergoing robotic single-site cholecystectomy (RESSC) with and without ICG was performed. Study revealed that ICG administered patients had shorter overall operative time. This also indicates that the use of ICG to enhance pre- and intra-operative decision making is a safe option as there is no statistically significant difference seen in two groups.

Conclusions
ICG coupled with a near infrared camera has the advantage of being nonionizing and is excreted virtually unchanged by the bile. This makes visualizing of biliary tree during cholecystectomies and hepatic procedures a common practice. ICG-enhanced laparoscopic surgery can be applied during different procedures offering to the surgeon additional information on anatomy, perfusion, or lymphatic drainage. ICG increases accuracy in detecting tissue abnormalities which helps surgeons make crucial decisions improving surgical outcomes of patients which can decrease recovery time and intra-operative complications.

Additional Clinical Application
Once injected into a peripheral or central vein, ICG becomes fluorescent under NIR light, providing a “real-time” confirmation of the bowel perfusion. Thus, this helps to define the point of resection after mesenteric division as well as demonstrates the presence of an ischemic or “non-optimal” perfusion before performing the anastomosis.

Vascular anatomy study of the spleen using ICG-enhanced fluorescence during laparoscopic splenectomy. On the right side, view using near infra-red light after injection of 5 ml of ICG. On the left side, view using standard light.

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