Timing of Indocyanine-Green (ICG) Administration in Robotic Assisted Laparoscopic Cholecystectomy

Hamza Khan[1], Jonathan S. Louw[2], Scott Gabriel[1], Jiashou Xu[1], Charles Chesnut[1], Matthew Swenson[1]

[1]Department of Surgery, Valley Health System
[2]Touro University, Nevada

Introduction

In the US, approximately 1.2 million cholecystectomies are performed annually. Although 90% are performed laparoscopically, the use of robot is taking over at a fast pace. Despite this rise in Robotic Assisted Laparoscopic Cholecystectomy (RALC), the optimal timing for ICG administration remains unclear.

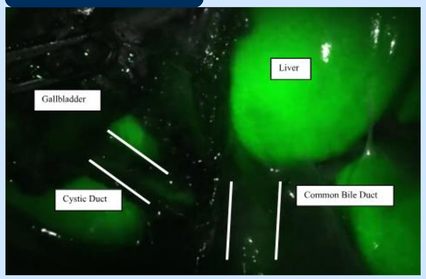
In this study we aim to determine the optimal timing of ICG in our single-center prospective cohort study among patients receiving RALC with ICG administration.

Methods

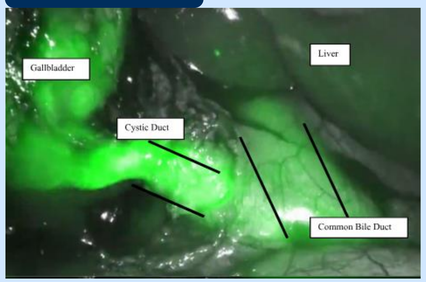
- Prospective cohort study at single institution
- Inclusion: Adult patients undergoing robotic
- Exclusion: Patients with severe inflammation or intraoperative bile/blood leakage
- Timing: April 2023 to August 2024.
- Outpatients were administered 7.5 mg ICG in the pre-operative hold, while inpatients received 7.5 mg ICG at varying times prior to surgery.
- ImageJ was used to measure the color intensity of the liver, common bile duct, and cystic duct and their Ratios were calculated.
- Statistical significance was determined using a t-test with $p<0.05$.

Figures

0.5-Hours Prior



7-Hours Prior



ICG administered 0.5 hours prior to surgery (top) compared to ICG administered 7 hours prior to surgery (bottom). As time passes, ICG is cleared by the liver and accumulates in the gallbladder.

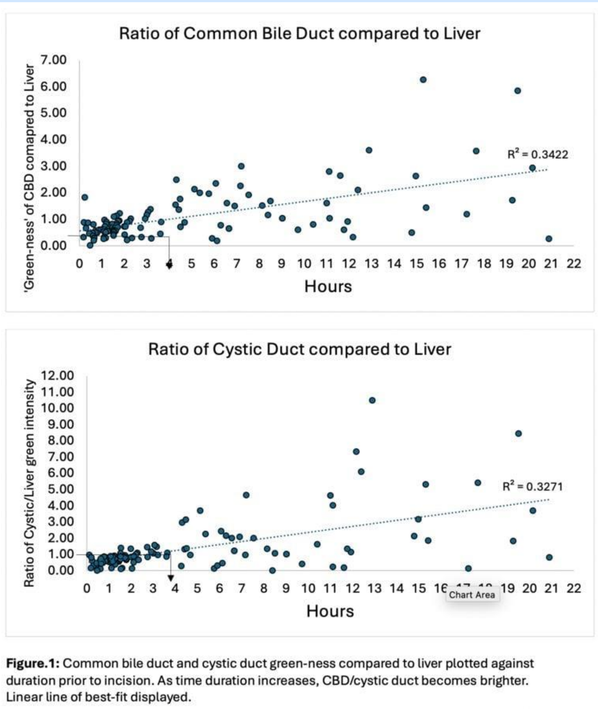


Figure.1: Common bile duct and cystic duct green-ness compared to liver plotted against duration prior to incision. As time duration increases, CBD/cystic duct becomes brighter. Linear line of best-fit displayed.

Common Bile and Cystic Duct green-ness compared to liber plotted against duration prior to incision. As the duration increases, the CBD & Cystic Duct becomes brighter than the liver.

Results

- A total of 216 patients were evaluated out of which, 113 patients were included in this study.
- There were 52 outpatients and 61 inpatients. Outpatients received ICG 1.2 (0.6-1.5) hours before incision, while inpatients received it 6.7 (4.2-11.6) hours prior.
- The CBD-to-liver ratio was significantly higher in inpatients compared to outpatients (1.50 ± 1.19 vs 0.65 ± 0.30, $p<0.01$).
- Similarly, the cystic duct-to-liver ratio was also higher in inpatients (2.06 ± 2.10 vs 0.67 ± 0.29, $p<0.01$).

- As the pre-operative ICG duration increased, the contrast between biliary structures and the liver improved. **<u>At approximately 3-4 hours, biliary structures appeared brighter than the liver.</u>**

Conclusion

- This study suggests that administering ICG 4 hours before RAL cholecystectomy can improve the visibility of biliary structures, making it easier for surgeons to identify and avoid critical anatomical landmarks.
- Individual patient factors such as hepatic clearance, peri-ductal tissue thickness, and inflammation can influence ICG uptake and contrast enhancement.
- Future research should investigate the impact of these factors on ICG administration timing and surgical outcomes in RAL cholecystectomy.