



COMPARATIVE EVALUATION OF INTRAVENOUS INDOCYANINE GREEN DYE FOR ASSESSMENT OF BILIARY ANATOMY AND TO ASSESS COMPLICATIONS IN LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE STUDY

Medical Science

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ABSTRACT

Background: laparoscopic cholecystectomy (LC) is commonly performed operative procedure to remove gall bladder stones. Fluorescence-enhanced IOC using indocyanine green (ICG) dye offers real-time visualization without radiation exposure and may improve operative safety. **Aim:** To compare outcomes of laparoscopic cholecystectomy performed with and without use of ICG dye in terms of biliary visualization, intraoperative complications, and postoperative recovery. **Methods:** A prospective comparative study was conducted on 120 patients with symptomatic cholelithiasis undergoing LC at SMIMER Hospital, Surat. Patients were randomized into two groups: Group A (ICG, n=60) received 2.5 mg ICG intravenously 45 minutes preoperatively, and Group B (non-ICG, n=60) underwent conventional laparoscopic cholecystectomy. Parameters analyzed included biliary visualization, detection of CBD stones, complications, and hospital stay. Statistical analysis was performed using SPSS v25, with $p < 0.05$ considered significant. **Results:** CBD visualization was significantly higher with ICG (96%) compared to non-ICG (87%, $p=0.04$). The cystic duct–CBD junction was more clearly defined with ICG (94% vs 82%, $p=0.02$). No bile duct injuries occurred in the ICG group, while three (5%) occurred in non-ICG patients. Mean hospital stay was shorter with ICG (3.6 days vs 4.4 days, $p=0.02$). **Conclusion:** ICG-assisted fluorescence cholangiography enhances biliary anatomy visualization and may reduce complications and recovery time. It is a safe, effective, and radiation-free adjunct to standard laparoscopic cholecystectomy.

KEYWORDS

Laparoscopic cholecystectomy, Indocyanine green, Fluorescence cholangiography, Bile duct injury

INTRODUCTION

Gallstone disease affects 10–20% of adults and is a major cause of surgical intervention. Laparoscopic cholecystectomy has become the gold standard for symptomatic cholelithiasis. However, bile duct injury remains a serious complication, most commonly caused by misidentification of biliary anatomy. Fluorescence cholangiography using indocyanine green offers a radiation-free, real-time alternative that can enhance intraoperative visualization. This study aimed to compare the efficacy and outcomes of ICG fluorescence IOC with standard fluoroscopic IOC during laparoscopic cholecystectomy.

MATERIALS AND METHODS

A prospective comparative study was conducted in the Department of General Surgery at Surat Municipal Institute of Medical Education and Research (SMIMER), Surat, over a 12-month period. A total of 120 patients with symptomatic cholelithiasis were enrolled and randomly assigned to two groups of 60 each.

Group A (ICG): Received pre-operatively 1ml of ICG intravenously 45 minutes prior to anesthesia induction. Fluorescence imaging was performed using a near-infrared (NIR) laparoscopic camera. Group B (Non-ICG): Underwent standard laparoscopic cholecystectomy without use of ICG dye.

All patients underwent standard four-port laparoscopic cholecystectomy. Parameters assessed included visualization of biliary structures, detection of CBD stones, intraoperative complications, and hospital stay. Data were analyzed using SPSS v25. Chi-square and Student's t-tests were used, with $p < 0.05$ considered statistically significant.

RESULTS

In our study, the mean age of participants was 37.63 years, indicating a relatively young study population. The majority (60.8%) were under 40 years of age, while 29.2% were between 41 and 60 years, and only 10% were over 60 years. There was a female predominance in both groups.

CBD visualization was achieved in 96% of ICG cases versus 87% in non-ICG cases ($p=0.04$). Cystic duct–CBD junction visualization was clearer with ICG (94% vs 82%, $p=0.02$). No bile duct injury occurred in the ICG group, while three (5%) occurred in the non-ICG group.

Mean hospital stay was significantly shorter in the ICG group (3.6 vs 4.4 days, $p=0.02$).

In our study, the mean operative time was significantly lower in the group where ICG dye was used (62 minutes) compared to the group without ICG (85 minutes). In our study, the mean operative time was significantly lower in the group where ICG dye was used (62 minutes) compared to the group without ICG (85 minutes). In our study, the mid-level CD–CBD junction was the most common anatomical finding, seen in 55 patients (91.7%) in the non-ICG group and 54 patients (90%) in the ICG group. A high junction was observed in 5 patients (8.3%) in the non-ICG group and 3 patients (5%) in the ICG group. Notably, a low junction was identified in 3 patients (5%) in the ICG group but in none of the patients without ICG.

DISCUSSION

ICG fluorescence cholangiography demonstrated superior biliary visualization. These findings align with studies by Dip et al. (2021) and Lim et al. (2023), which reported visualization rates above 95% using ICG. Fluorescent imaging eliminates radiation, provides continuous real-time visualization, and assists in early identification of biliary structures before cystic duct cannulation. In our study, the ICG group showed improved safety, with no bile duct injuries and a shorter hospital stay. These results suggest that ICG fluorescence can enhance operative safety and efficiency during laparoscopic cholecystectomy.

CONCLUSION

ICG-assisted fluorescence cholangiography is a safe and effective adjunct to laparoscopic cholecystectomy. It significantly improves biliary anatomy visualization, facilitates safer dissection, and may reduce postoperative morbidity and hospital stay. Its selective or routine use should be encouraged, particularly in complex cases where biliary anatomy is obscured.

LIMITATIONS AND RECOMMENDATION

This was a single-center study with a moderate sample size. Long-term outcomes and cost-effectiveness were not assessed. Further multicentric trials are recommended to validate these findings.

DECLARATIONS

Ethical Approval: Approved by the Institutional Ethics Committee of SMIMER Hospital, Surat.

Informed Consent: Obtained from all individual participants included in the study.

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Conflict Of Interest: The authors declare no conflict of interest.

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