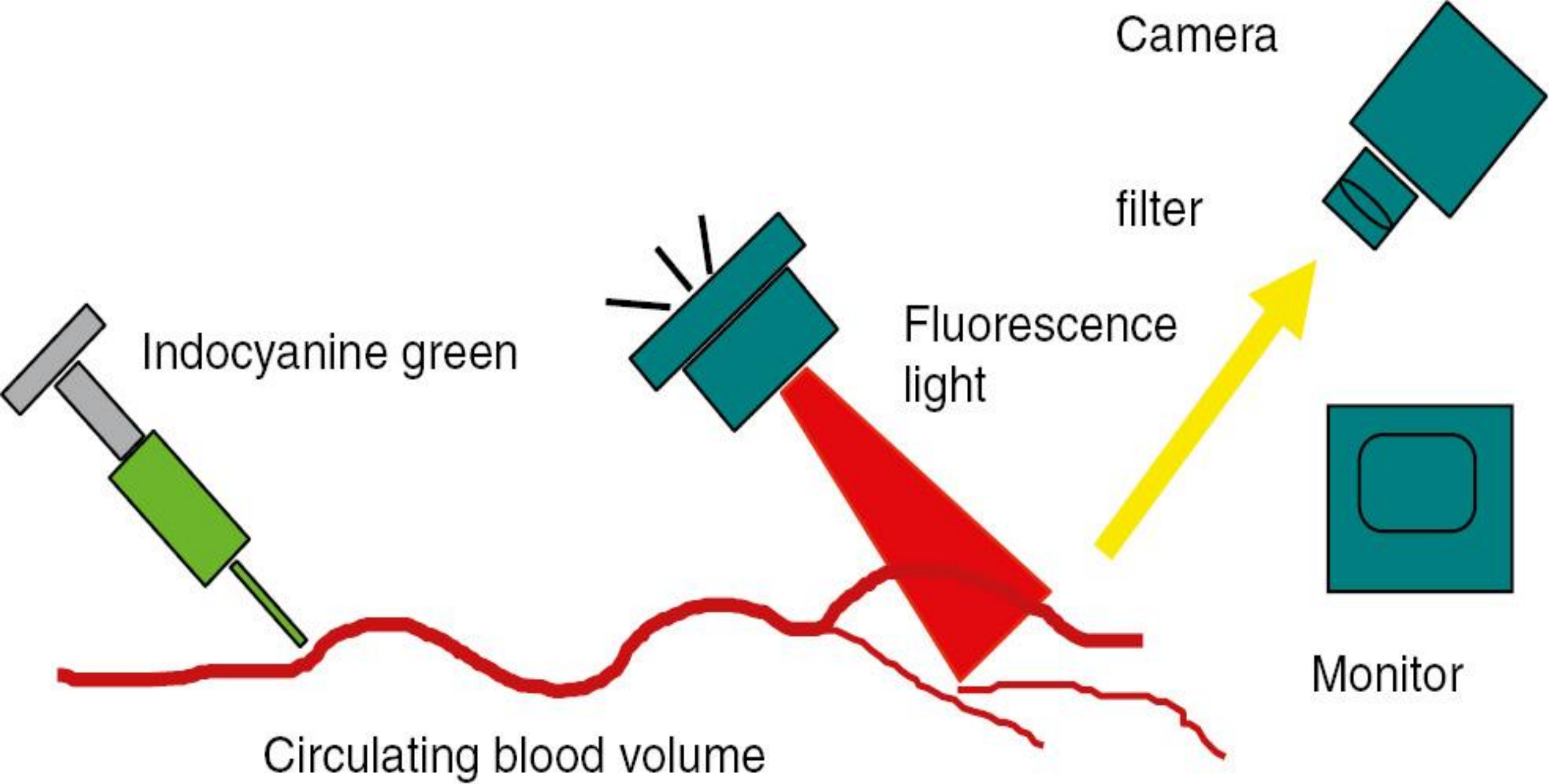


Applications of Indocyanine Green in Surgery

Talha Ahmed, Manohar Pai

Department of General Surgery, Kasturba Medical College, Mangalore,
Manipal Academy of Higher Education

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2. Aim and Objectives

- Aim – To employ ICG in routinely performed surgical operations like Laparoscopic cholecystectomy, Intestinal Colorectal Anastomosis, Hernia (Elective/Emergency) Cases, Sentinal Lymph node Mapping in Oncological cases, Vascular surgery and Plastic Surgery cases with Flap reconstruction.
- Objectives –
 - ✓ To visualize the biliary tract anatomy in performing a “Safe” Laparoscopic Cholecystectomy.
 - ✓ To assess the vascularity of the resected ends of bowel and assess bowel viability.
 - ✓ To identify sentinal lymph nodes in oncological cases.
 - ✓ To assess the vascularity of an ischemic limb to predict stump healing.
 - ✓ To evaluate the vascularity of different flap procedures (Local/Advancement) to predict its healing.

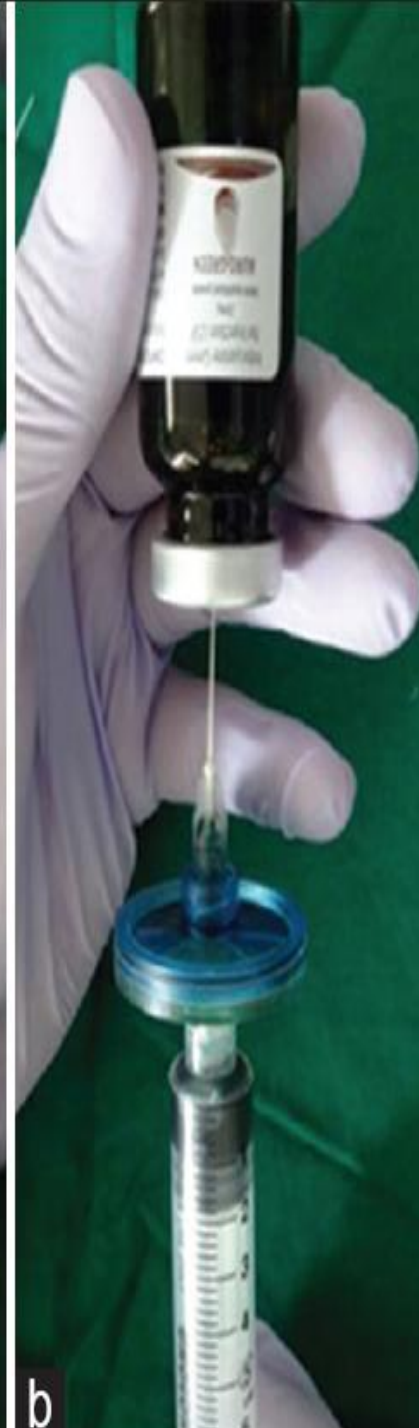
3. Materials and Methods

- Inclusion Criteria –

- a) Patients admitted for both elective and emergency cases.
- b) Conducted between 2019-2023.
- c) All patients aged 18 years and above with indications falling within the objectives of the study were considered.

- Exclusion Criteria –

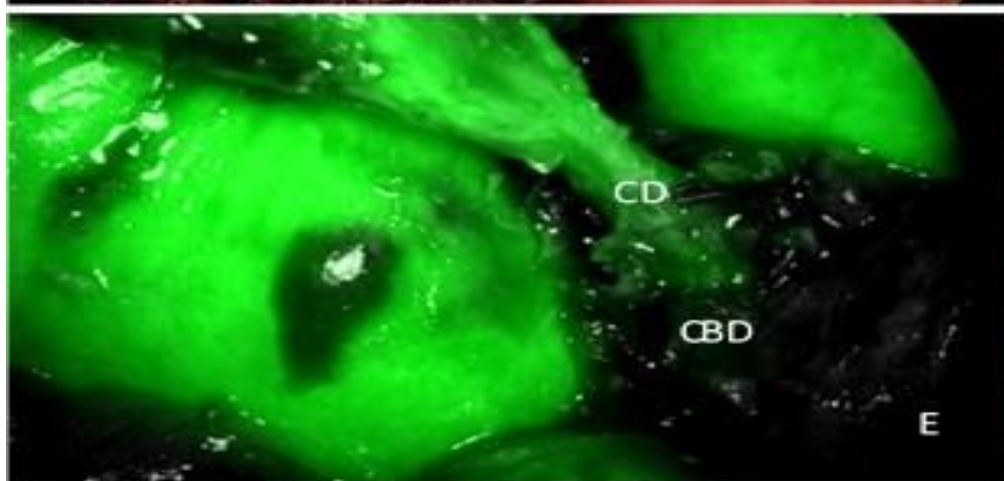
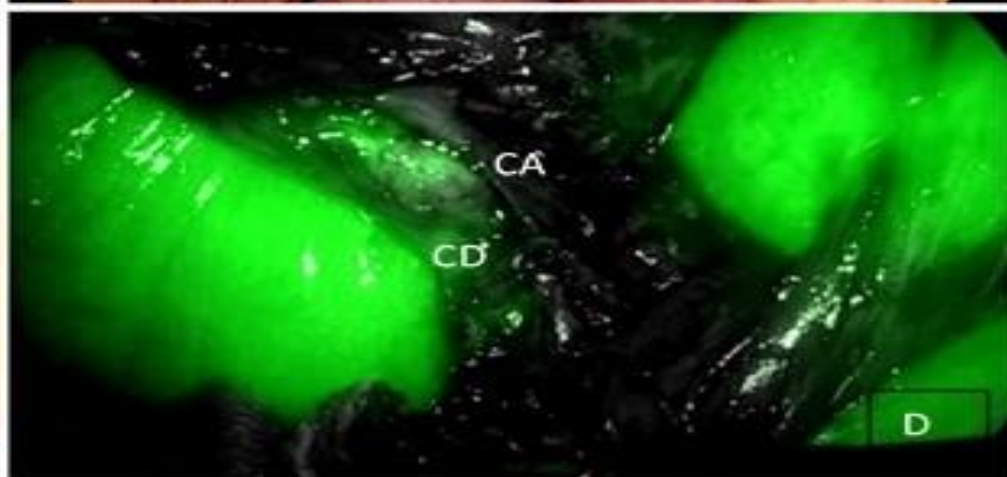
- a) History about hypersensitivity reaction to ICG dye and/or compounds containing iodine.
- b) Pregnant and lactating mothers were excluded.



4. Results

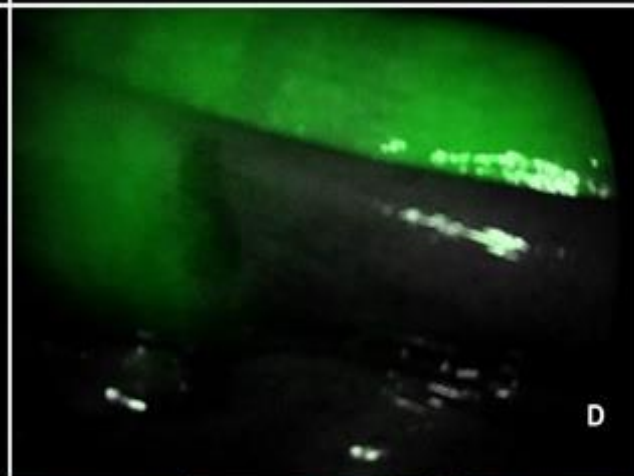
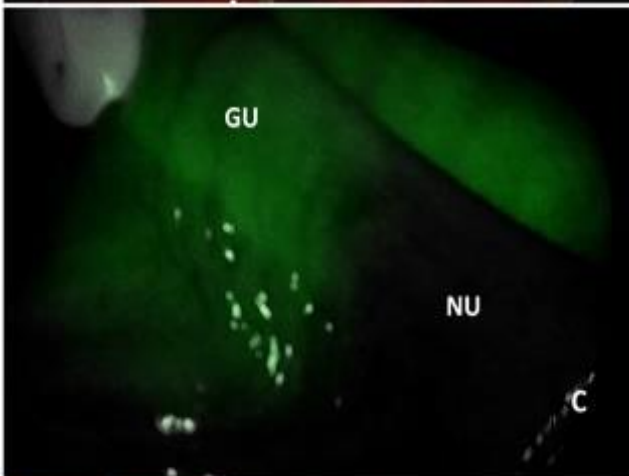
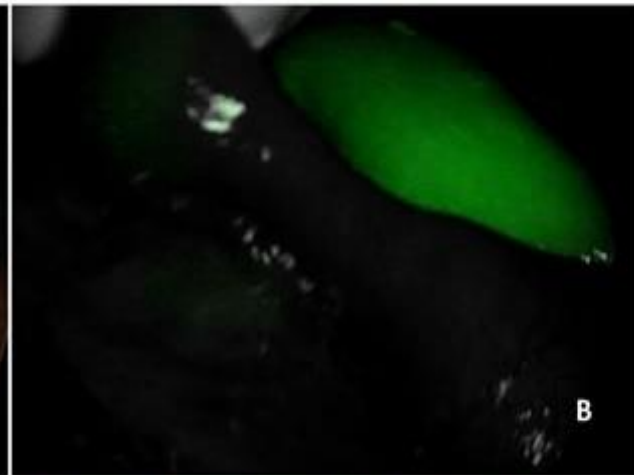
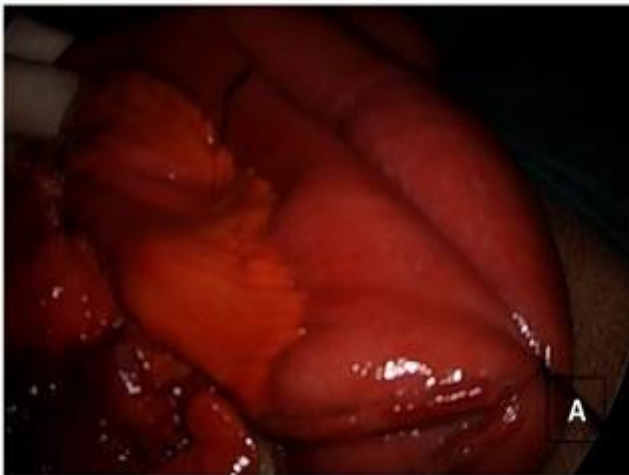
4.1. APPLICATION OF ICG IN LAPAROSCOPIC CHOLECYSTECTOMY

- Bile duct injury has a prevalence of 0.4%, which can go up to 4% in acute cholecystitis.⁵
- Biliary anatomy is highly variable and challenging.
- 5 mg (1ml) of reconstituted dye was given IV two hours prior to the incision.
- 70 laparoscopic cholecystectomies were performed in a span of 1 year.
- 35 Symptomatic Cholelithiasis, 12 Acute cholecystitis, 8 Chronic cholecystitis, 15 Choledocholithiasis who underwent ERCP and then interval cholecystectomy.
- Critical view of safety was achieved.
- We report accurate localization of the biliary tree including CBD in 100% of the patients regardless of the complication status.



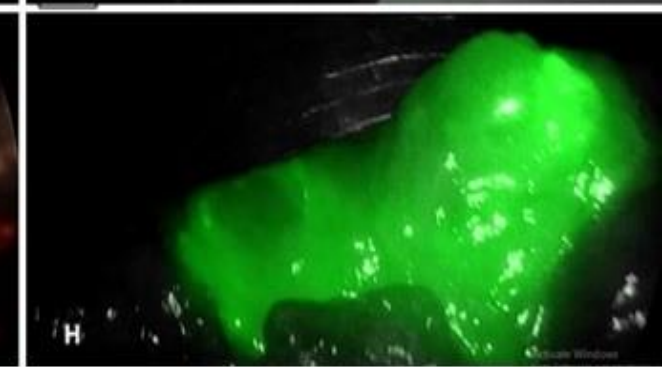
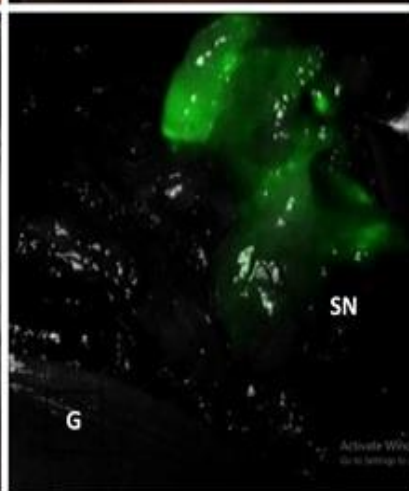
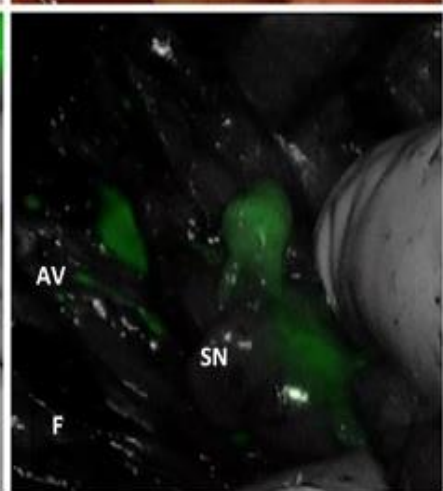
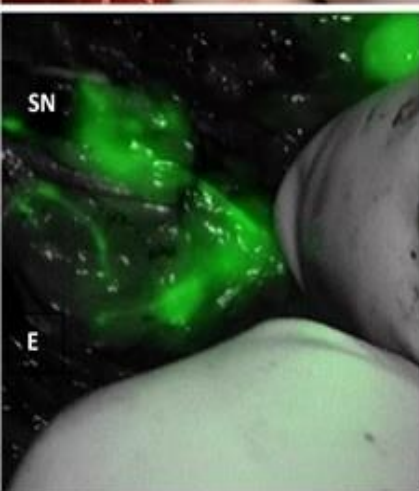
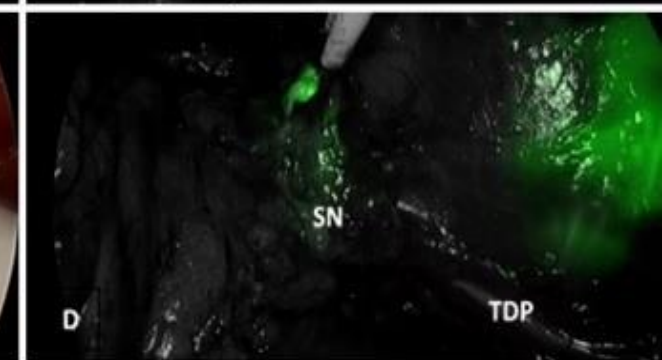
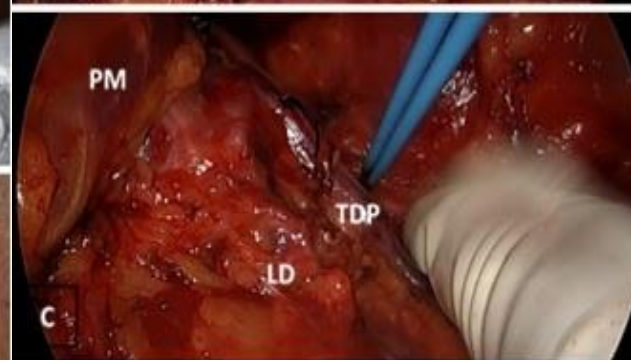
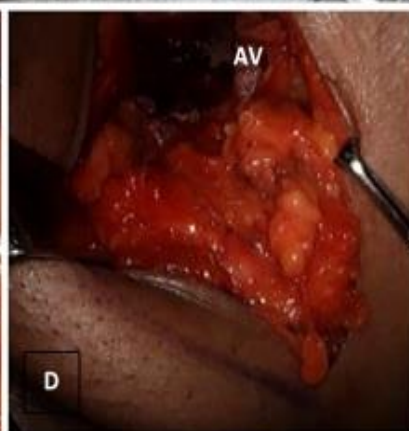
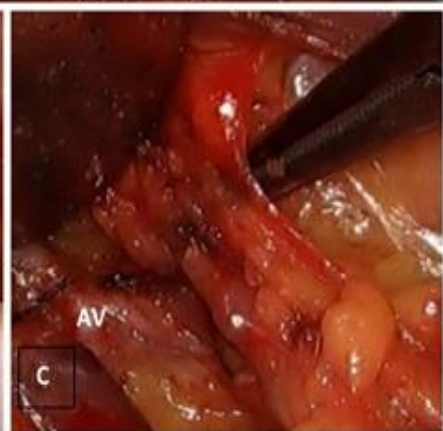
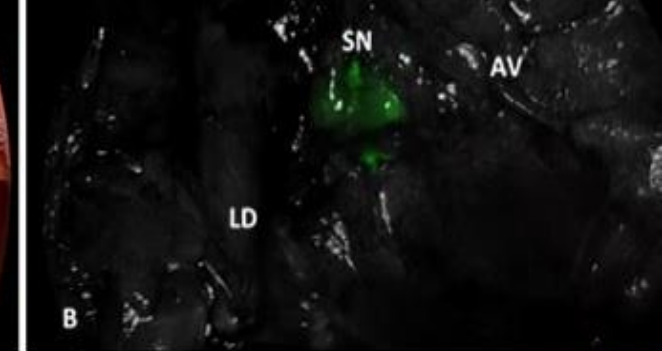
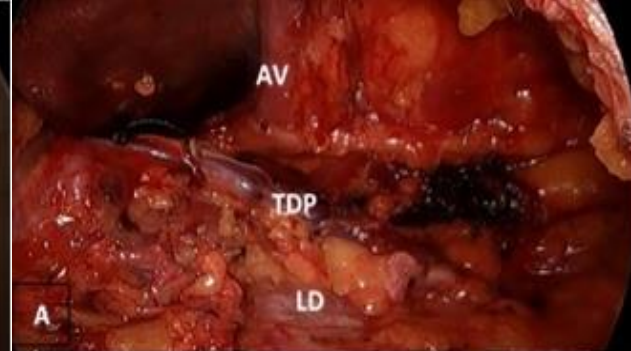
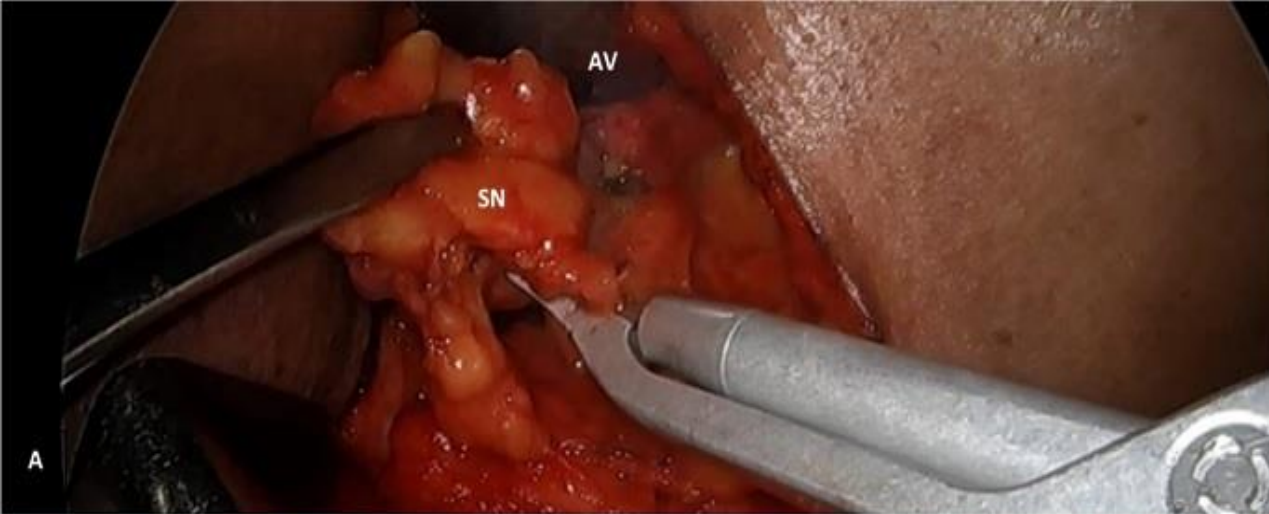
4.2. APPLICATION OF ICG TO ASSESS BOWEL VIABILITY

- Incarcerated hernia with intestinal obstruction has a mortality rate of around 3%, which may rise up to 20% in cases of bowel resection.
- Visual inspection under standard white light to assess perfusion and viability based on color, pulsations, peristalsis, bleeding from cut edges.
- This is an unreliable method due to low accuracy of predicting ischemia and the decisions of different surgeons are vastly objective.⁶
- 5 cases were described.
- 7.5mg (1.5mL) of ICG dye was administered IV.
- Fluorescence was observed within 60sec, with areas of good uptake showing bright green fluorescence and poor uptake being visualized as dark areas.



4.3. APPLICATION OF ICG FOR MAPPING OF SENTINEL LYMPH NODE

- Sentinel node is the first point of entry to a nodal basin. For a cancer to metastasize, it must first pass through the sentinel node.
- Blue dye technique - anaphylaxis, skin tattooing, skin necrosis and bluish discoloration of urine. ⁷
- Radionucleotide method - technetium 99 tagged sulfur colloid – expensive, handling and disposal of radioactive substance. ⁸
- 6 cases of biopsy proven Breast Cancer, 5 cases of Oral Malignancies and 2 cases of skin malignancies
- 5mg (1ml) of ICG dye was injected in the peri tumor region/ peri areolar region.
- 10 minutes post injection, the local lymph node basin was explored to identify the sentinel node.



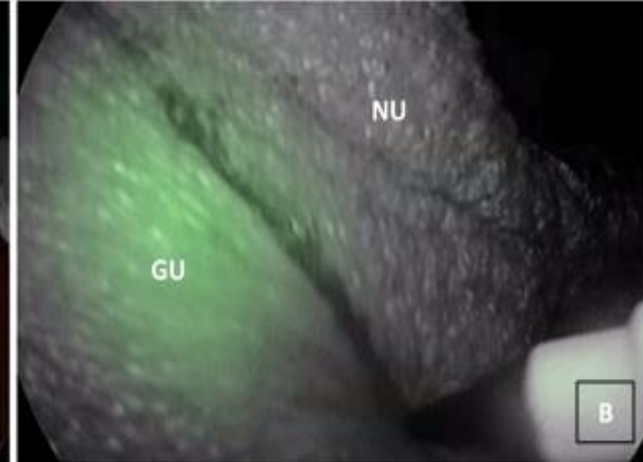
4.4. APPLICATION OF ICG IN VASCULAR SURGERY TO ASSESS STUMP VASCULARITY AND LEVEL OF AMPUTATION

- Peripheral arterial occlusive disease present with gangrene, ischemic ulcer and pain.
- Healing is doubtful which becomes pronounced when an amputation is planned.
- Healing is hampered due to the poor perfusion, thereby subjecting the patient towards a re-amputation.
- The level of amputation is always in doubt with the surgeon pushed into a dilemma of not cutting too much versus cutting too little and comprising the healing of the stump.



4.5. APPLICATION OF ICG IN ASSESSING FLAP VASCULARITY AND UPTAKE

- Reconstruction following major resection surgery is one of the most crucial events for both closures of defects as well as cosmetic purposes.
- The vascular supply of the flap is the single most important factor determining the healing and uptake of the transferred tissue.
- 9 cases of Breast Cancer and 3 cases of Oral Malignancy were taken into the study undergoing different flap reconstructions post removal of primary.
- 7.5mg (1.5ml) of ICG was given to visualize the green fluorescence on the edges of the skin margins using NIV mode, 60 sec post injection.



5. Conclusion

- Fluorescence imaging using ICG-NIV camera has revolutionized common and routinely performed surgical procedures to minimize post-operative complications.
- ICG is easily available, non-invasive with a wide margin of safety.
- It remains the only fluorophore to be used in humans.
- Due to its short half-life it can be used in patients with renal dysfunction and can be employed for multiple administrations.
- ICG fluorescence is a promising apparatus in standard general surgical procedures minimizing untoward errors and improving patient conformance and reducing personalized barriers to surgery

6. References

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