Use of indocyanine green dye clearance in a patient with liver cirrhosis undergoing hepatectomy: a clinical image

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DESCRIPTION

Indocyanine green (ICG) is a water-soluble, non-toxic tricyanocyanine dye extracted exclusively from the hepatic parenchyma. Measurement of ICG clearance using pulse spectrophotometry is a simple, reproducible and non-invasive test, easily performed in the operating room. ICG plasma disappearance rate (PDR) and the retention rate at 15 min (R15) produce real-time metrics to aid assessment and decision-making before, during and after complex liver surgery. ICG clearance has also been used to suggest the presence of postoperative complications, including thrombosis of the hepatic artery and graft dysfunction following liver transplantation. We present a case of 65-year-old Caucasian man, with Child-Pugh A liver cirrhosis undergoing complex right hepatectomy for metastatic colorectal liver cancer where ICG clearance impacted on the extent of surgical resection.

Given the concerns about marginal postoperative liver function of the residual left hepatic lobe, we used pulse spectrometry intraoperatively to predict the risk of postoperative liver dysfunction. Immediately preoperatively, a dose of 20 mg (0.25 mg/kg) ICG dye was dissolved in 20 mL of distilled water (figure 1) and injected into the right internal jugular vein through a central venous catheter, over a 3 s period. PDR and R15 were recorded with a LiMON-Technology device (Pulsion Medical System SE, Germany) and automatically calculated in accordance with the time course of the blood ICG concentration. The PDR was 19.8%/min and the R15 was 6.7%, quantitatively reflecting normal parenchymal function. Intraoperatively, after dissection of the portal vessels, we applied selective arterial and venous inflow trial clamping to the right portal vein and hepatic artery. A further dose of 20 mg (0.25 mg/kg) ICG dye was injected which demonstrated a PDR of 14.8%/min and R15 of 10.9% (figure 2). This quantitatively reflected acceptable postoperative parenchymal functional reserve and flow conditions of the residual left liver lobe.^{1 2} The postoperative risk of liver dysfunction was considered adequate given the curative intent of the surgery. The patient underwent an uncomplicated right hepatectomy.

On postoperative day 1, ICG measurements were repeated, revealing clinically reassuring changes in ICG values compared with the intraoperative measurements. The PDR was 15.7%/min, and R15 was 8%. Parenchymal enzymes aspartate transaminase (AST) and alanine transaminase (ALT) peaked on the third postoperative day (AST 260 IU/mL; ALT 557 IU/mL), then returned abruptly to baseline values on

Figure 1 Preparation of indocyanine green for intravenous injection.

postoperative day 5. Prothrombin time elevated within 48 hours postoperatively to a peak value of 17 seconds, normalising on postoperative day 4. Partial thromboplastin time and total serum bilirubin levels remained essentially normal throughout the entire postoperative course. Albumin fell to approximately 50% of normal, gradually rising to near baseline values by postoperative day 6. The patient made an uneventful recovery, except for developing a mild ileus, and was discharged home on postoperative day 7.

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Figure 2 Trace of the concentration of indocyanine green (ICG) in the plasma over time. Displayed are the calculated plasma disappearance rate (PDR) and ICG retention at 15 min (R15) values. CI, cardiac index; HR, heart rate; SpO₂, oxygen saturation.

Learning points

- ▶ Indocyanine green (ICG) is a water-soluble, non-toxic tricarboyanine dye extracted exclusively from the hepatic parenchyma.
- ▶ Change in concentration of ICG over time can be measured using non-invasive pulse dye densitometry.
- ▶ ICG clearance provides valuable dynamic information about liver function, predicting postoperative risk of liver dysfunction during and after liver resection and transplant surgery.

Our case highlights the clinical utility of using ICG testing to dynamically predict postoperative risk of liver dysfunction during major liver resection surgery in a patient with cirrhosis. The use of decisional algorithms based on ICG clearance to select liver resective procedures according to liver functional reserve should be considered in patients with cirrhosis who are being planned for minor or major liver resection surgery.¹⁻³

Contributors LW was the principal anaesthetist who cared for the patient. He performed all the intraoperative indocyanine green (ICG) tests. He was responsible for the design and conception of the report. He helped perform the literature review, was the lead author and prepared the submission of this manuscript. VM was the principal surgeon managing the patient. He was involved in the conception and design of this clinical image and helped prepare the manuscript. SKG was the surgical assistant involved in this case. He helped perform the ICG testing in theatre, and was responsible for the assisting with the literature review and the writing of the manuscript. CR helped perform the literature review, prepare the images and assisted in the writing of the manuscript.

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