RECENT PUBLICATIONS ON NEAR-INFRARED CHOLANGIOGRAPHY

1. ***Surgery Paper on Near-Infrared Cholangiography***

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Does near-infrared fluorescent cholangiography with indocyanine green reduce bile duct injuries and conversions to open surgery during laparoscopic or robotic cholecystectomy? — A meta-analysis

Fernando Dip, MD[a,b], Emanuele Lo Menzo, MD, PhD[b], Kevin P. White, MD, PhD[c], Raul J. Rosenthal, MD[b,*]

[a] Department of Surgery, Hospital de Clínicas José de San Martín, University of Buenos Aires, Argentina
[b] Department of General Surgery, Cleveland Clinic Florida, Weston, FL
[c] ScienceRight Research Consulting, London, ON, Canada

Key points from the paper [1.]

- "Using near-infrared fluorescent cholangiography with indocyanine green intraoperatively sizably decreases bile duct injury and conversion-to-open–surgery rates relative to cholecystectomy under white light alone
- The meta-analysis included 6,000 patients comparing minimally invasive cholecystectomy complications using NIFC with ICG and non-NIFC approaches
- The analysis reveals a *4-fold lower rate of bile duct injury* (BDI)
- And more than ***17-fold lower rate of conversions to open surgeries when NIFC is used***

Other statistics that helps support value of reducing reoperation rate and BDI's

Cost of BDI and open surgery complications

- By reducing complications, profit margins at hospitals are maintained. Profit margins drop from 13% to 1% when complications in lap chole surgeries occur [2.]
- Overall average cost of reoperation associated with bile duct injuries was US$13,935 [3.]
- Average length of hospital stay due to bile duct complications - up to 15 days [3,4.]
- With approximately 750,000 cholecystectomies being performed in the United States annually, an estimated 2,500 patients per year are expected to be affected by a BDI [5.]

2. ***Near-Infrared Incisionless Fluorescent Cholangiography Offers Better Visualization of Biliary Tree***

Separately a piece from Dr Rosenthal appeared on the publication General Surgery News highlighting reasons why to choose NIFC for patients. [6.]

14 GREAT DEBATES GENERAL SURGERY NEWS / DECEMBER 2020

Near-Infrared Incisionless Fluorescent Cholangiography Offers Better Visualization of the Biliary Tree

Raul J. Rosenthal, MD, FACS, FASMBS

Clinical Professor of Surgery Cleveland Clinic Lerner College of Medicine at Case Western Reserve University, Ohio

Chairman, Department of General Surgery

Director, General Surgery Residency Program Cleveland Clinic Florida, Weston

Since Carl Langenbuch's first description of an open cholecystectomy in 1831, the surgeon-on-call's main concern has been how to prevent a bile duct injury. The introduction of IOC, by Pablo Mirizzi in 1931, significantly improved the morbidity and mortality of this operation, since surgeons could better visualize and recognize the anatomy of the extrahepatic biliary tree. Open cholecystectomy became standard of care for symptomatic or complicated gallstone disease with a bile duct injury rate of 0.3%.

Erich Muhe's introduction of the laparoscopic approach in 1985 resulted in a dramatic improvement in the overall outcomes of this operation. Patients experienced a shorter hospital length of stay by decreasing pain and wound complications. However, in parallel with the above-mentioned benefits of minimally invasive access surgery, the number of bile duct injuries doubled in frequency, to 0.6%. Way et al demonstrated that the most common reasons for bile duct injury occurrence while performing laparoscopic cholecystectomy are the loss of tactile feedback with laparoscopy in conjunction with the misidentification of biliary structures and its frequent anatomic variation that can be identified in 19% of cases.[1]

Although the incidence of bile duct injury at 0.6% appears to be low, this complication becomes a significant one if we take into account the potential for major morbidity and mortality and the fact that we perform well over 750,000 laparoscopic cholecystectomies annually in the United States. Different approaches have been proposed to avoid injury. Strasberg described the critical view approach of safety dissecting the Calot's triangle and identifying the cystic artery and extrahepatic biliary ducts.[2] Other authors proposed the routine use of fluoroscopic IOC instead. Unfortunately, regardless of implementing the above-mentioned techniques and approaches, the number of bile duct injuries remains unchanged.

In 2009, Ishizawa et al first published the utilization of NIFC to better visualize the biliary tree when performing biliary and liver surgery.[3] This novel technique uses a fluorescent dye (indocyanine green) that, when activated by near-infrared light, allows the surgeon to properly detect structures during surgery that otherwise cannot be visualized with white light alone. Ishizawa demonstrated that NIFC delineated the cystic duct in all 52 patients, and the cystic duct–common hepatic duct junction was visible before dissection of Calot's triangle in 50 of the 52 patients.[4]

Different publications have described the utility of this technique in order to visualize the extrahepatic bile ducts. There is no doubt that the method is feasible and accurate. But in order to establish the method as a standard of care, or at least as a recommendation, it is important to determine the real impact of this technique during LC in different pathologies and patients.

In a previously published randomized controlled trial by our group, Dip et al compared NIFC plus white light with conventional white light alone for the identification of extrahepatic biliary anatomy during LC.[5] The study determined that pre-dissection detection rates of extrahepatic biliary structures and anatomic landmarks were significantly superior in the NIFC group compared with the one using white light alone. The better visualization of anatomic landmarks included accessory ducts, cystic ducts, right hepatic duct, common hepatic duct, common biliary duct, cystic–common bile duct junction and cystic–gallbladder junction. Furthermore, following dissection, similar differences were observed for all structures except cystic ducts and cystic–gallbladder junction. Although not significant, there were only two bile duct injuries in this study and three conversions, all of them in the group that used white light alone.

When implementing the critical view of safety as a surgical approach to avoid a bile duct injury, extensive dissection needs to be performed, which by itself can result in injury.

There are multiple reasons why NIFC should be implemented on a routine basis when performing LC. It is relatively inexpensive compared with IOC; it does not require radiation and because of that, it can be used in pregnant women; it provides the surgeon with a direct image that can be repeated endlessly without the need for radiation or cannulation of the cystic duct; the image is real and does not require interpretation as it does for IOC; it gives some tactile sensation back to the surgeon since he can touch the structure that is lighting up; and finally, what is more important, it does not require extensive dissection and it is incisionless. When implementing the critical view of safety as a surgical approach to avoid a bile duct injury, extensive dissection needs to be performed, which by itself can result in an injury. Similarly, when performing an IOC, the surgeon must make an incision to cannulate the cystic duct, the latter becoming a bile duct injury if this is the incorrect anatomic location.

NIFC should be implemented routinely during LC, not because it should replace the critical view of safety or selective use of IOC, but because it becomes a critical complement to the above-mentioned maneuvers to prevent bile duct injury occurrence. ■

A Surgeon and His Art

"Off to His Paris Bookie," A Watercolor by Gerald Marks, MD

The 2014 World Congress of Surgical Endoscopy, in addition to being a grand reunion of old friends, was a perfect opportunity to explore a favorite city in search of painting material. Paris is a city of energetic urban activity ready for painting, and I walked the streets day after day shooting photos at random. I discovered I had captured a candid image of a prototypical waiter hurrying to someplace only to be imagined in an unknown back story. Was he off to his bookie? Who knows? I have kept his image alive, placing him in paintings in Rome and Mantova, and now where he belongs—in Paris.

References

1. Way LW, Stewart L, Gantert W, et al. Causes and prevention of laparoscopic bile duct injuries analysis of 252 cases from a human factors and cognitive psychology perspective. *Ann Surg.* 2003;237(4):460-469.
2. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. *J Am Coll Surg.* 1995;180(1):101-125.
3. Ishizawa T, Bandai Y, Kokudo N. Fluorescent cholangiography using indocyanine green for laparoscopic cholecystectomy: an initial experience. *Arch Surg.* 2009;144(4):381-382.
4. Ishizawa T, Bandai Y, Ijichi M, et al. Fluorescent cholangiography illuminating the biliary tree during laparoscopic cholecystectomy. *Br J Surg.* 2010;97(9):1369-1377.
5. Dip F, LoMenzo E, Sarotto L, et al. Randomized trial of near-infrared incisionless fluorescent cholangiography. *Ann Surg.* 2019;270(6):990-999.

If you have suggestions for topics for future Great Debates, contact the editor at **khorty@mcmahonmed.com**.

Here is a summary of some of his key arguments on benefit of NIFC

How many more reasons do you need to choose NIFC?

1. It relatively inexpensive compared to IOC
2. It does not require radiation

 Queries: info@diagnosticgreen.com

3. Provides surgeon with direct image that can be repeated
4. The image is real and does not require interpretation
5. It does not require extensive dissection
6. It is incisionless
7. Lower chance of Bile Duct Injuries compared to non NIFC approach
8. Lower chance of having to move to open procedure

References

1. Dip F, Lo Menzo E, White K, Rosenthal R; Does near-infrared fluorescent cholangiography with indocyanine green reduce bile duct injuries and conversions to open surgery during laparoscopic or robotic cholecystectomy? — A meta-analysis Surgery (IF 3.356) DOI: 10.1016/j.surg.2020.12.008
2. Healy, M.A; Mullard, A.J; Campbell, D.A Jr; Dimick, J.B. Hospital and Payer Costs Associated With Surgical Complications. JAMA Surg. 2016;151(9):823-830.
3. Hofmeyr S, Krige JE, Bornman PC, et al. A cost analysis of operative repair of major laparoscopic bile duct injuries. S Afr Med J 2015; 105(6):454-7.
4. Halbert C, Altieri MS, Yang J, et al. Long-term outcomes of patients with common bile duct injury following laparoscopic cholecystectomy. Surg Endosc 2016; 30(10):4294-9.
5. Schreuder, A. M., Busch, O. R., Besselink, M. G., Ignatavicius, P., Gulbinas, A., Barauskas, G., … van Gulik, T. M. (2019). Long-Term Impact of Iatrogenic Bile Duct Injury. Digestive Surgery, 1–12. doi:10.1159/000496432
6. General Surgery News, December edition https://www.generalsurgerynews.com/Section/Digital-Editions/512 (page 14)

