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Original Paper

SURGICAL OUTCOMES FOLLOWING FLUORESCENCE CHOLANGIOGRAPHY-GUIDED LAPAROSCOPIC CHOLECYSTECTOMY IN PATIENTS WITH MODERATE ACUTE CHOLECYSTITIS

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In patients with moderate acute cholecystitis, there is an increased risk of iatrogenic bile duct injury during laparoscopic cholecystectomy. Fluorescence cholangiography (FC) can improve visualisation of extra hepatic bile ducts intra-operatively and can assist in achieving critical view of safety (CVS) principles. The present prospective observational study focuses on the efficacy of FC with indocyanine green (ICG) in patients with moderate acute cholecystitis who underwent laparoscopic cholecystectomy at our department between October 2021 and April 2024. We compared visualisation rates of extrahepatic bile ducts, both before and after achieving CVS along with FC-ICG. We were also interested in the post-operative surgical outcomes. Descriptive statistics were used to present our results. In our cohort of 33 patients (52% female) with moderate acute cholecystitis, the acute gangrenous subtype (56.2%) was the most common followed by the acute phlegmonous form (43.8%). The median operative time was 85 minutes with three patients requiring conversion to an open approach. When comparing before and after CVS achievement, FC-ICG improved the visualisation of extrahepatic biliary tree structures including the cystic duct (52% vs 70%), common bile duct (48% vs 70%), and common hepatic duct (33% vs 46%). Median hospitalisation duration was six days with no patient reporting any post-operative complications. Consequently, the median post-operative patient well-being score was 80%. FC-ICG improves the visualisation of extrahepatic biliary tree structures during laparoscopic cholecystectomy in patients with acute moderate cholecystitis, thereby increasing success rates and reducing complication rates.

Keywords: *difficult cholecystectomy, visualisation, image guided surgery, indocyanine green, CVS.*

INTRODUCTION

Acute cholecystitis (AC), defined as inflammation of the gallbladder, is a common surgical emergency that requires prompt surgical attention. In approximately 95% of cases, AC is caused by an obstruction of the cystic duct due to gallstones, a condition known as acute calculous cholecystitis (ACC) (Gallaher *et al.,* 2022). The remaining cases are typically associated with gallbladder ischaemia or occur in the context of severe critical illness. ACC represents the most frequent complication of cholelithiasis and accounts for 14–30% of all cholecystectomies performed in many countries (Orlando *et al.,* 1993; Shaffer *et al.,* 2006; Sartelli *et al.,* 2015). Furthermore, ACC is recognised as the second most common source of complicated intra-abdominal infection.

The severity of AC is classified according to the Tokyo Guidelines 2018 (Yokoe *et al.,* 2012). Moderate AC represents one of the most frequent surgical emergencies, accounting for more than half (56.8%) of all AC cases according to observations from a prospective Spanish study (Escartin *et al.,* 2021). According to the guidelines, moderate or Grade II AC is defined by the presence of at least one of the following criteria: symptom duration exceeding 72 hours, white blood cell (WBC) count 18,000/mm^3, a palpable tender mass in the right upper quadrant, or radiological evidence of local inflammation such as gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, emphysematous cholecystitis, or bile peritonitis (Yokoe *et al.,* 2012).

Laparoscopic cholecystectomy (LC) is the standard of care for patients with AC. In most cases, the procedure can be completed without complications; however, in moderate AC the operative course is notably more challenging. In patients with moderate AC, the reported complication rate with LC is 43%, whereas the mortality rate is 3.6% (Gonzalez *et al.,* 2023). Factors that increase intra-operative difficulty include obesity, anatomical variations of the extrahepatic bile ducts (EHBD), post-pancreatic infiltration, as well as adhesions. These factors may culminate in considerable technical difficulties during LC.

Furthermore, in such patients structural changes in response to inflammatory processes (peri-vesical inflammation, tissue oedema and empyema) may alter the anatomy of the bile ducts, making dissection and visualisation of these structures considerably more difficult. Under these circumstances, gallbladder dissection from the liver bed and visualisation of critical structures (cystic duct and artery) can be more challenging and can lead to intra- or post-operative complications. The most significant complication is iatrogenic bile duct injury (IBDI), which can result in severe morbidity requiring prolonged patient care. IBDI rates are estimated to range from 0.3% to 0.8% in LC (Ramar *et al.,* 2025). Clinical consequences of IBDI are often severe. It can lead to biliary leakage, sepsis, long-term gastrointestinal diseases, and can necessitate liver transplantation. This not only diminishes the patients' quality of life but also places a significant burden on the healthcare system due to prolonged treatment and repeated surgeries.

Therefore, it is essential to employ all available means to reduce the risk of IBDI during surgery. The cornerstone of preventing IBDI is correct identification of the biliary anatomy. For this purpose, the Critical View of Safety (CVS) protocol was established and is globally recognised as the gold standard. CVS requires clear identification of the cystic duct and cystic artery, as well as complete separation of the lower part of the gallbladder from the liver bed prior to clipping. When these criteria are met, the surgery can proceed safely. Nonetheless, CVS in acute moderate cholecystitis can be challenging. Achieving complete CVS is not always recommended or necessary as it may increase the risk of severe inflammation, which could subsequently lead to IBDI. Such situations arise when dealing with patients aged 60 years, male gender, emergency admission, history of biliary interventions and history of acute cholecystitis (Nassar *et al.,* 2021).

In these cases, CVS alone is not enough, and complementary imaging modalities are needed. Fluorescence cholangiography (FC) using indocyanine green (ICG) is one such technique which enables real-time visualisation of EHBD structures through near-infrared fluorescence. This is performed by administering ICG intravenously, after which it is excreted from the liver into the bile and can be detected under near-infrared (NIR) light. When images are captured with an NIR camera, the bile ducts become clearly distinguishable from the surroundings. This enables visualisation of the EHBD structures prior to dissection. For example, if the inflamed tissue is 10 mm, the visibility of EHBD structures is obscured completely. In this case one can start to dissect *ligamentum hepatoduodenale* and switch from white light mode (WLM) to ICG mode, which enables visualisation of EHBD structures. Hence, in this study, we examined the benefits of FC in LC surgeries involving patients with acute moderate cholecystitis. Our aim was to determine whether FC-ICG improves visualisation of the EHBD prior to achieving CVS and after CVS completion.

MATERIALS AND METHODS

This prospective study was conducted at the Department of General and Emergency Surgery, Rīga East Clinical University Hospital (RAKUS), Rīga, Latvia, between October 2021 and April 2024.

Patient selection. Eligible participants were adult patients diagnosed with moderate acute cholecystitis according to the Tokyo Guidelines 2018 criteria (Yokoe *et al.,* 2012). Accordingly, diagnosis was established based on clinical evaluation, laboratory findings, and imaging modalities such as transabdominal ultrasound. Exclusion criteria included complicated gallstone disease, known iodine allergy or hypersensitivity, and patients with contraindications to laparoscopic surgery or general anaesthesia, and patients requiring immediate surgical intervention, i.e. those cases where surgery could not be delayed for 12 hours post-admission (to allow for the ICG dye to be administered intravenously). Patients who declined or withdrew informed consent were also excluded.

Surgical procedure. All patients underwent laparoscopic cholecystectomy with intraoperative FC under general anaesthesia. ICG dye was administered intravenously approximately 12 hours before surgery, at a dose of 12.5 mg diluted in 10 ml of saline. Surgical interventions were performed by a team of certified hepato-pancreato-biliary (HPB) surgeons experienced in laparoscopic ICG-based imaging. A conventional four-trocar technique was utilised. After establishing pneumoperitoneum, the gallbladder was retracted cranially. Intraoperative visualisation assessments were performed both pre- and post-dissection using the SYSTEM GREEN® ICG/near-infrared (NIR) fluorescence imaging platform (Richard Wolf GmbH, Germany). Cystic duct and artery ligation was achieved using haemoclips. Laparoscopic cholecystectomies were performed following the eight-step Critical View of Safety (CVS).

Conversion to open surgery was undertaken in select cases, either in cases of severe peri-vesical inflammation or when no visualisation of the critical structures (cystic duct, cystic artery) was obtained intra-operatively. All surgical procedures were video recorded using a 4K endoscopic camera system (ENDOCAM Logic 4K Camera Controller, Richard Wolf GmbH, Germany) inserted via the umbilical trocar. Postoperatively, all patients received standard management in line with international guidelines, including antimicrobial therapy and multimodal analgesia. Complication assessment and clinical evaluation were conducted prior to discharge from the department.

Intraoperative visualisation assessment. Before visceral peritoneum dissection, the visualisation quality of extrahepatic bile duct (EHBD) structures was assessed under both white light mode (WLM) and fluorescence cholangiography (FC) modes. The FC mode was performed using an 800–850 nm wavelength light source (LEDgreen, Richard Wolf GmbH, Germany) with a single toggle switch allowing seamless transition between WLM and FC overlay modes. After the dissection of the cystic duct and artery, visualisation was reassessed using the same modalities. A five-point Likert scale (1 = poor, 5 = excellent, see Appendix 1) was used to grade visualisation quality. Score validation was performed both during surgery and postoperatively via video review by a single certified surgeon, showing strong concordance between intraoperative and postoperative assessments.

Data collection and analysis. Perioperative data were prospectively collected by certified surgeons using patient medical records and clinical examinations. The dataset included patient demographics, clinical presentation, laboratory parameters, intraoperative findings, length of hospital stay, pathohistological findings, drainage tube insertion and removal, and patients' post-operative subjective well-being score. We recorded postoperative complications classified according to the Clavien-Dindo system. All data were anonymised using unique patient identifiers prior to analysis.

No formal sample size calculation was conducted; a purposive convenience sampling method was applied. Given the single group presentation of our data, we used descriptive statistics to present our observations. For categorical variables, raw counts (N) and percentage (%) were used while for numerical continuous variables we used median and inter-quartile range (IQR). Median as a central tendency was chosen due to the small sample size and non-Gaussian distribution of the data as validated by the Shapiro-Wilk test. Descriptive analyses were conducted using Microsoft Excel 365 (Windows 11) and IBM SPSS Statistics version 29.0.0 (IBM Corp., USA).

RESULTS

During the study period, 33 patients fulfilled the criteria for moderate acute cholecystitis and were therefore included in the final analysis. There was a near equal split in terms of male and female patients (48% vs 52%) with median age of 64 years (range 24 to 86 years). Median body mass index was 28 kg/m^2 (IQR 6.6). As expected, at hospital admission, laboratory tests showed elevated levels of inflammatory markers, including white blood cell count (median $14*10^9$ cells/l; IQR 5.5) and C-reactive protein (median 42 mg/l; IQR 67.5).

Intraoperative findings. The median operative time was 85 minutes (IQR 37.5). We observed that two-thirds (67%) of the patients exhibited peri-vesical infiltration, with gallbladder empyema being observed in more than half of the patients (55%). Conversion to open cholecystectomy was required in three patients (9%) due to technical difficulties and inability to achieve adequate visualisation of the cystic duct.

Visualisation of the extra hepatic bile ducts. The visualisation rates drastically improved following CVS in comparison with before CVS for all EHBD structures. Before achieving CVS, the cystic duct was identified in slightly more than half of the patients (51.5%). However, the visualisation rate improved to 70% following CVS (McNemar test $p = 0.070$). Similarly, for the common bile duct, visualisation rates significantly rose from 48% before CVS to 70% after CVS (McNemar test $p = 0.039$). For the common hepatic duct, the visualisation rate increased from 33% before CVS to 46% after CVS (McNemar test $p = 0.219$; Fig. 1). Additionally, after CVS, when using both regular WL mode and FC mode, critical structures such as the cystic duct was identifiable in 91% of patients (Fig. 2). In fact, in just three patients, the cystic duct could not be visualised intraoperatively.

Visualisation quality assessment. While visualisation rates were noted to increase for all structures, overall, CVS did not yield a significant change in ICG visualisation quality (Table 1) in moderate acute cholecystitis patients. For the cystic duct, *sufficient* ratings increased from 21% to 27%, despite fewer higher-tier scores ($p = 0.341$). For the common bile duct, *sufficient* ratings also rose slightly, from 24% to 27%, with stable lower-tier ratings ($p = 0.737$). The clearest gain, however, was for the common hepatic duct, where *poor* ratings fell from 73% to 48% and *sufficient* rose from 9% to 52%, suggesting a trend towards improved adequacy after CVS.

Number of CVS steps performed and ICG visualisation. More than four CVS steps were achieved in 29 (88%) pa-

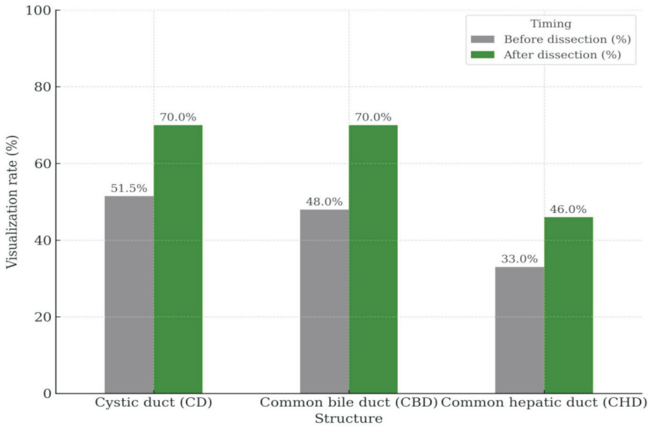

Fig. 1. Effectiveness of fluorescence cholangiography for the visualisation of bile duct structures before (gray bars) and after (green bars) the achievement of critical view of safety (CVS) principles.

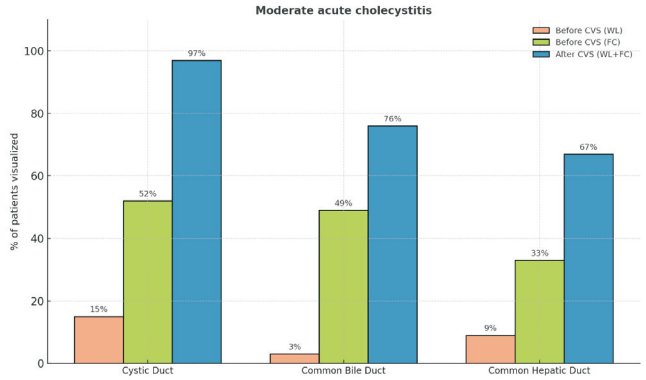

Fig. 2. Percentage of the patients visualised bile duct structures before critical view of safety (CVS) using white light (WL), before CVS using fluorescence cholangiography (FC) and after CVS using both modes (WL+FC).

Table 1. Assessment of quality of visualisation before and after CVS (presented as n, %)

Structure	CVS	Likert scoring					Wilcoxon signed rank *p* value
		Poor	Sufficient	Almost good	Good	Excellent	
Cystic duct	Before	16 (49%)	7 (21%)	4 (12%)	6 (18%)	0 (0%)	0.341
	After	24 (72%)	9 (27%)	0 (0%)	0 (0%)	0 (0%)	
Common bile duct	Before	17 (52%)	8 (24%)	4 (12%)	3 (9%)	1 (3%)	0.737
	After	24 (72%)	9 (27%)	0 (0%)	0 (0%)	0 (0%)	
Common hepatic duct	Before	24 (73%)	3 (9%)	3 (9%)	2 (6%)	1 (3%)	0.100
	After	16 (48%)	17 (52%)	0 (0%)	0 (0%)	0 (0%)	

CVS, critical view of safety

Table 2. Distribution of patients (n, %) based on number of CVS steps performed and ICG visualisation for all anatomical localisations

Structure	ICG visualisation	No. of CVS steps performed		Fisher's exact *p* value
		0–4 steps	5–8 steps	
Cystic duct	Helpful	0 (0%)	16 (49%)	0.103
	Not helpful	4 (12%)	13 (39%)	
Common bile duct	Helpful	0 (0%)	15 (46%)	0.108
	Not helpful	4 (12%)	14 (42%)	
Common hepatic duct	Helpful	0 (0%)	9 (27%)	0.555
	Not helpful	4 (12%)	20 (61%)	

CVS, critical view of safety

tients. We observed that for moderate acute cholecystitis patients, ICG was generally not helpful when only 0–4 CVS steps were completed. However, with 5–8 steps of CVS, ICG was considered helpful 49% of the times for the cystic duct and 46% of times for the common bile duct. Helpfulness was lower for the common hepatic duct: 27% times helpful vs 61% not helpful with 5–8 steps. No structure showed a significant association between ICG helpfulness and CVS steps (Table 2).

Change in background liver fluorescence before and after CVS. Although the overall rates of disturbance in background fluorescence remained low (3% to 9%), the rates varied depending on the EHBD structure visualised. These rates notably increased following the achievement of CVS for all structures (Table 3). For example, the rates of background disturbance increased from 6% before CVS to 9%

Table 3. Proportional distribution of patients (n, %) based on the assessment of background liver fluorescence before and after CVS

Structure	Before CVS	After CVS		McNemar test *p* value
		not disturbed	disturbed	
Cystic duct	Not disturbed	30 (91%)	1 (3%)	1.000
	Disturbed	0 (0%)	2 (6%)	
Common bile duct	Not disturbed	30 (91%)	1 (3%)	1.000
	Disturbed	0 (0%)	2 (6%)	
Common hepatic duct	Not disturbed	32 (97%)	0 (0%)	1.000
	Disturbed	0 (0%)	1 (3%)	

CVS, critical view of safety

after CVS for the cystic duct and common bile duct (p = 1.000). For the common hepatic duct, no changes in disturbance rates were observed (3% before and after CVS; p = 1.000).

Patho-histological findings. Among the 33 patients with moderate acute cholecystitis, most patients were diagnosed with the acute gangrenous subtype (56.2%; n = 19), while the remaining patients (43.8%; n = 14) had the acute phlegmonous form.

Intra-abdominal drainage. Except for one patient, intra-abdominal drainage was inserted in all patients in our cohort. Among the 32 patients who required drainage, we evaluated the time to drain removal.

In the study group, the median time to drain removal was two days (IQR 1).

Post-operative well-being score. Patients with moderate acute cholecystitis reported a high overall subjective post-operative well-being score, with a median of 80% (IQR 10%).

Post-operative outcomes. As anticipated, the median white blood cell count (median $10*10^9$ cells/l; IQR 4.5) decreased while C-reactive protein content (median 60 mg/l; IQR 105.5) increased post-operatively. The median hospitalisation time was six days (IQR 4.5). All patients were classified as Grade I according to the Clavien-Dindo classification in terms of postoperative complications, with no cases of dropout. No patient required total parental nutrition, blood transfusion, surgical re-intervention, or dialysis. No surgical site infections or bilio-vascular injuries were noted. Furthermore, no mortality was noted.

DISCUSSION

This prospective single-centre study evaluated the use of FC-ICG during LC in patients with moderate AC. Our findings indicate that NIR imaging substantially improved intraoperative visualisation of the biliary anatomy, particularly before attainment of the CVS. By clarifying key structures early in the operation, NIR guidance may support safer dissection and potentially reduce the risk of IBDI, which remains one of the most serious complications of cholecystectomy. Although not new, previous reports on ICG-based imaging have focused on elective surgery. To our knowledge, this is the first detailed evaluation of the effectiveness of FC during LC specifically in patients with moderate AC.

Several studies, including those by Kamarajah *et al.* (2020), Lim *et al.* (2021), and Dip *et al.* (2021), have shown that FC helps visualise biliary anatomy, especially in difficult cases. All patients in our cohort met the 2018 Tokyo Guidelines criteria for moderate inflammation, and in this setting the technique performed well. In more than 90% of patients, the cystic duct was visualised after CVS when using combined white-light imaging plus FC. This finding is consistent with earlier studies, such as Boni *et al.* (Ankersmit *et al.,* 2017), who reported that the timing of ICG injection influenced visualisation rates and related outcomes.

Misidentifying the common bile duct as the cystic duct is among the most serious intra-operative errors in cholecystectomy and typically arises when inflammation obscures normal anatomy (Way *et al.,* 2003). Even with FC, we were unable to safely delineate the cystic duct in three patients, necessitating conversion to open surgery. These findings reinforce that, although the technology is a valuable adjunct, it cannot completely substitute for sound surgical judgment. Additionally, we observed that more than a half of patients had empyema, and 67% had peri-vesical infiltration. Dissection is typically made more challenging in moderate cholecystitis patients; however, our conversion rate was only 9%, which aligns with previous reports documenting conversion rates of 20–25% in comparable circumstances (Hu *et al.,* 2017; Cholecovid collaborative, 2022).

There were no significant post-operative complications noted. There were no wound infections or bile duct injuries, and no patient required re-operation. These results are consistent with prior studies by Peter *et al*., and Ishizawa *et al.* (Vu *et al.,* 2023), who likewise reported low complication rates when using ICG for biliary imaging. Furthermore, drainage was usually removed within 48 hours, and patient-reported postoperative well-being was high, both of which may indicate reduced surgical trauma attributable to more confident dissection.

A common counterpoint against FC-ICG use is the use of intraoperative cholangiography (IOC). We have employed IOC as well, but it requires more time, entails radiation exposure, and can at times complicate the operative workflow. FC, by contrast, is a relatively straightforward process, with a short learning curve once the system is established. Buchs *et al.* (Lim *et al.,* 2021) compared the two methods and found FC to be faster while providing comparable anatomical information, which reflects our experience as well. At the same time, one must consider the financial implications with FC-ICG implementation. While the dye and imaging system are expensive, so too is a bile duct injury, both medically and legally. Pesce *et al*. (Reeves *et al.,* 2021) suggested that, for hospitals performing at least 50 cholecystectomies per year, FC could be more cost-effective. Our experience also supports these findings with considerable cost savings overall after an upfront investment in equipment and materials.

Nonetheless, this study has several limitations. The sample size recruited was small. All procedures were performed by experienced hepatobiliary surgeons, a factor that likely contributed to the more favourable outcomes and may limit generalisability to centres with less specialised expertise. In addition, visualisation was scored by a single evaluator, introducing potential subjectivity despite efforts to standardise assessments. This choice of single-rater assessments was made keeping in mind the high expertise of the assessor in HBP surgeries and to avoid inter-rater variations in an already small sample size. All surgeries were video documented, and these assessments could be used for training and baseline comparisons in future cohorts with larger sample sizes.

The optimal timing of ICG administration also remains contentious. In our protocol, ICG was administered 12 hours preoperatively. Other teams have reported the use of intervals at 45–90 minutes before surgery, arguing shorter timings may reduce hepatic background fluorescence (Van den Bos *et al.,* 2018). When we adopted the technique at our centre in 2017–2018, we followed a 45–60 min interval as recommended in literature at the time. However, we observed a significant background fluorescence disturbance in our patients, affecting the utility of the technique. To reduce this disturbance, over the years we shifted to an earlier 12-hour protocol. Our interval yielded a robust and consistent biliary signal, which was particularly helpful when dissection was slow or delayed, as is typical in gallbladder inflammation. At the same time, we observed a significant lower proportion of background fluorescence disturbance (as noted in our results < 10%). Similar observations have been noted elsewhere, where another group also reported favourable outcomes with longer dosing intervals (Tsutsui *et al.,* 2017). Nonetheless, we acknowledge that currently there are no head-to-head trials reported that compare different dosing intervals in moderate acute cholecystitis patients. This remains an area of active debate and investigation in the field and future research could shed light on optimal dosing intervals.

Another limitation is the lack of data about long-term postoperative outcomes including re-admissions and biliary complications. Similarly, the single-centre setting of our study limits generalisability — as seen by the inability of our sample size to reach required statistical power to detect a meaningful difference. As this was a pilot study in Latvia, we plan to conduct systemic multi-centre randomised trials with centres in Latvia and other Baltic countries. This would help us to validate the applicability of our findings. In summary, our findings suggest that FC-ICG is a valuable adjunct to LC in moderate acute cholecystitis patients. It does not completely replace the need for surgical skill or vigilance yet, but it can meaningfully support difficult cases by enhancing visualisation and facilitating safer intra-operative decision-making.

CONCLUSIONS

FC-ICG is a safe and effective method for enhanced identification of EHBD structures in patients with moderate AC and complex local inflammatory changes. When combined with the CVS principles, it enables a high rate of visualisation and identification of critical anatomical structures and reduces the risk of iatrogenic bile duct injury.

ETHICS

The study protocol was prepared and implemented in accordance with the ethical standards described in the Declaration of Helsinki, 2008. Ethical approval was obtained from the Medical and Biomedical Research Ethics Committee of the RAKUS Support Foundation (#9-A/20; dated 6 August 2020). Written informed consent was obtained from all participating patients.

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ĶIRURĢISKIE IZNĀKUMI PACIENTIEM AR VIDĒJI SMAGU AKŪTU HOLECISTĪTU PĒC LAPAROSKOPISKAS HOLECISTEKTOMIJAS AR FLUORESCENCES HOLANGIOGRĀFIJU

Pacientiem ar vidēji smagu akūtu holecistītu laparoskopiskas holecistektomijas laikā pastāv paaugstināts jatrogēnu žultsvadu bojājuma risks. Fluorescences holangiogrāfija (FH) var uzlabot ekstrahepātisko žultsvadu vizualizāciju operācijas laikā un palīdzēt veikt drošu holecistektomiju. Prospektīvs pētījums, kurā tiek analizēta indocianīna zaļā (ICG) un fluorescences holangiogrāfijas (FH) efektivitāte pacientiem ar vidēji smagu akūtu holecistītu, kuriem neatliekamā kārtā tika veikta laparoskopiskā holecistektomija laika posmā no 2021. gada oktobra līdz 2024. gada aprīlim. Pētījuma ietvaros tika salīdzināti ekstrahepātisko žultsvadu vizualizācijas rādītāji pirms un pēc *Critical View of Safety* (CVS) izpildes, izmantojot FH-ICG. Tika analizēti pēcoperācijas ķirurģiskie rezultāti. Rezultāti tika atspoguļoti, izmantojot aprakstošo statistiku. Kopumā tika iekļauti 33 pacienti (52% sievietes) ar vidēji smagu akūtu holecistītu; visbiežāk konstatētais patohistoloģiskais apakštips bija akūts gangrenozs holecistīts (56,2%), kam sekoja akūts flegmonozs holecistīts (43,8%). Vidējais operācijas ilgums bija 85 minūtes, un trim pacientiem bija nepieciešama pāreja uz atvērta tipa holecistektomiju. Salīdzinot vizualizāciju pirms un pēc CVS sasniegšanas, FC-ICG uzlaboja ekstrahepātisko žultsvadu struktūru redzamību, tostarp *ductus cysticus* (52% pret 70%), *ductus choledochus* (48% pret 70%) un *ductus hepaticus communis* (33% pret 46%). Vidējais hospitalizācijas ilgums bija sešas dienas, un nevienam pacientam netika novērotas pēcoperācijas komplikācijas. Attiecīgi vidējais subjektīvais pēcoperācijas pašsajūtas novērtējums bija 80%. FH-ICG uzlabo ekstrahepātisko žultsvadu struktūru vizualizāciju laparoskopiskas holecistektomijas laikā pacientiem ar vidēji smagu akūtu holecistītu, tādējādi palielinot drošas operācijas izpildi un samazinot komplikāciju risku.

Appendix 1. Postoperative evaluation of extrahepatic bile duct anatomy visualisation (assessed immediately after surgery, in the operating room)

	YES	NO	Likert scale*				
			1 - Poor	2 - Fair	3 - Almost good	4 - Good	5 - Excellent
Visualisation of cystic duct (CD)							
Before dissection							
After dissection							
Visualization of common bile duct (CBD)							
Before dissection							
After dissection							
Visualisation of CD and CBD confluence							
Before dissection							
After dissection							
Visualisation of common hepatic duct (CHD)							
Before dissection							
After dissection							
Visualisation of CD insertion into gallbladder							
Before dissection							
After dissection							

*Likert scale is used to assess the quality of biliary structure visualisation before and after tissue dissection.