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Selective Intraoperative Cholangiography in Laparoscopic Cholecystectomy

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Rezumat

Colangiografia intraoperatorie selectivă în colecistectomia laparoscopică

Introducere: Colecistectomia laparoscopică (CL) este probabil cea mai frecvent efectuată intervenție chirurgicală la nivel mondial. Colangiografia intraoperatorie (CIO) este necesară mai des decât în intervențiile deschise pentru a clarifica anatomia sau pentru a diagnostica litiaza de cale biliară principală (CBP).
Scop: Studiul prezent analizează valoarea CIO efectuată selectiv după criterii pre şi intraoperatorii. Experiența noastră acoperă 15 ani de activitate chirurgicală în Secția de Chirurgie a Spitalului Elias şi rezultat al interesului ştiințific continuu asupra temei, am elaborat un set de criterii care sunt analizate şi discutate.
Material şi metodă: Am studiat pacienții care au suferit CL în secția noastră între Ianuarie 2013 şi Decembrie 2014. Este analizat un grup de 945 de pacienți; CIO a fost efectuată în 147 de cazuri. Toate CIO au fost proceduri selective. Criteriile au fost împărțite în două grupuri: • Criterii preoperatorii (clinice, laborator, imagistice); • Criterii intraoperatorii (căi biliare dilatate şi anatomie biliară neclară).
Rezultate: CIO a fost efectuată în 147 de cazuri. Am obținut un rezultat pozitiv, o descoperire care a modificat managementul chirurgical al pacientului după CIO în peste 50% din cazuri. Anatomia arborelui biliar a fost clarificată în 100% din cazuri. CIO a necesitat o perioadă medie de 11 minute. Nu a fost complicații cauzate de CIO.
Concluzii: Colangiografia intraoperatorie, efectuată de rutină sau selectiv, reprezintă un mijloc important de diagnostic al calculilor CBP în timpul colecistectomiei laparoscopice. Criteriile pentru CIO selectivă ar putea reduce semnificativ numărul de colangiografii inutile şi sunt de considerat în practica zilnică. În studiul nostru, factorii predictivi principali utilizați pentru colangiografia intraoperatorie selectivă sunt: antecedentele de icter, valorile crescute ale ALT, AST, GGT, FA şi diametrul CBP.

Cuvinte cheie: colangiografia intraoperatorie, colecistectomia laparoscopică

Abstract

Introduction: Laparoscopic cholecystectomy (LC) is probably one of the most frequent surgical procedure performed worldwide. Intraoperative cholangiography (IOC) is required more often than in open procedures due to the need to clarify the anatomy or to diagnose common bile duct (CBD) stones.
Aim: The present study analyzes the value of IOC performed on selective basis following preoperative and intraoperative criteria. Our experience covers 15 years of surgical activity in Elias Surgery Department and, as a result of a continuous scientific concern on the matter, we developed a set of criteria that are analyzed and discussed.
Material and method: We studied the patients subjected to LC in our department between January 2013 and December 2014. A group of 945 patients was analyzed; IOC was per-

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formed in 147 cases. All IOC were selective procedures. The criteria were divided in two groups: • Preoperative criteria (clinical, lab tests and imaging findings); • Intraoperative criteria (dilated biliary ducts and obscure biliary anatomy).
Results: IOC was performed in 147 cases. We had a positive result, a finding that changed surgical management of the patient after IOC in over 50% of cases. The biliary tree anatomy was cleared in 100% of cases. IOC required a median period of time of 11 minutes. There were no complications caused by IOC.
Conclusions: Intraoperative cholangiography, performed either routinely or selectively, represents an important tool in diagnosing unsuspected CBD stones during laparoscopic cholecystectomy. Criteria for selective IOC may significantly reduce the number of useless cholangiograms and are to be considered in daily practice. The main predictive factors used for selective intraoperative cholangiography in our study were: history of jaundice, elevated values of ALP, GGTP, SGO, SGP, and CBD diameter.

Key words: intraoperative cholangiography, laparoscopic cholecystectomy

Introduction

Nowadays, laparoscopic cholecystectomy (LC) is the selective procedure for the treatment of uncomplicated symptomatic gallstones. Classical advantages of minimal access technique are painless postoperative period and small scars. Intraoperative cholangiography (IOC) in the course of LC is valuable in detecting common bile duct (CBD) stones, delineating the anatomy of the biliary ducts, in facilitating dissection, avoiding injuries to the biliary tract and in identifying other abnormalities, such as fistulas, cysts and tumors of the biliary system. Cholangiography should be achieved via the cystic duct before any structures are transected, as this can obviate the most serious complication of LC – injury of theCBD (1,2).

The routine versus selective use of IOC has been the subject of debate eversince. According to R J. Fitzgibbons, Jr.: "perhaps there is nothing in general surgery that excites more of an emotional debate than the issue of routine versus selective operative cholangiography, whether is dealing with conventional or laparoscopic cholecystectomy. This issue will almost certainly be debated until general surgery itself is obsolete" (3).

In early 90th, routine intraoperative cholangiography during LC was advocated. A cholangiogram cannot always prevent choledochotomy but can decrease the rate of CBD injury. Thus, an IOC should always be performed in cases where the anatomy is not clear. Principal indications for examination of the CBD during cholecystectomy are jaundice or a history of jaundice, a dilated/thickened common duct, elevated liver function tests, a palpable common duct stone, a history of biliary colic, multiple small stones in the gallbladder, cholangitis, and gallstone pancreatitis. The highest positive predictive value for choledocholithiasis are jaundice, elevated liver function tests and a dilated/thickened CBD have. Routine cholangiography increases the cost when comparing with selective cholangiography and also increases the cost of an uncomplicated LC. (4,5).

CBD stones are detected more often when IOC is used routinely rather than selectively and the management of these unexpected ductal stones found during LC in the era of laparoscopic surgery is still controversial. Before the introduction of new endoscopic techniques (ERCP/endoscopic papillotomy – "EPT") and laparoscopy, open surgery was the gold standard for management of choledocholithiasis (6,7).Today, preoperative ERCP/EPT followed by LC is considered to be the concept of choice for most surgeons. This two-step procedure is generally accepted because of its significant lower complication and mortality rate when compared to open bile duct surgery (8,9,10,11). In contrast, a Germany-wide survey reported a surprisingly high rate for initial open bile duct management of ~11.6% (12). Although ERCP is quite efficient in the management of ductal stones, it has a morbidity rate of 7-11% and a mortality of <1%, especially if accompanied by endoscopic sphincterotomy (13).

Total one stage laparoscopic approach including cholecystectomy and CBD drainage avoids the complications of sphincterotomy and represents a new alternative requiring some improvements of surgical skills.

The purpose of the present study is to analyzewhetherselective intraoperative cholangiography can be performed with good results following some principles according to preoperative and intraoperative data.

Method

Nine hundred forty five patients underwent cholecystectomy in a 2 year period (January 2013 – December 2014) in the Surgery Department of the Elias Hospital. Data from hospital records, operative notes, cholangiographic studies, and follow-up of all patients were analyzed.

Fifty eight patients who underwent open surgery and 73 additional patients with obvious jaundice and documented CBD stones were excluded from the study. Inclusion criteria were LC and unobvious CBD stones (jaundice at presentation or CBD stones on abdominal US) resulting in 824 patients. (*Fig. 1*)

Intraoperative cholangiography was performed selectively according to 2 types of predictive criteria:preoperative and intraoperative.

The preoperative predictive criteria were:

- clinical (acute cholecystitis, history of jaundice, cholangitis or pancreatitis,suggestive symptoms with no gallstones seen on the abdominal ultrasound);
- lab tests (cholestasis): ALS, ALT, GGT, ALP;
- imaging findings (CBD larger than 6 mm on US, suggestive for a distal obstacle without a positive diagnosis of CBD stones).

The intraoperative predictive criteria were:

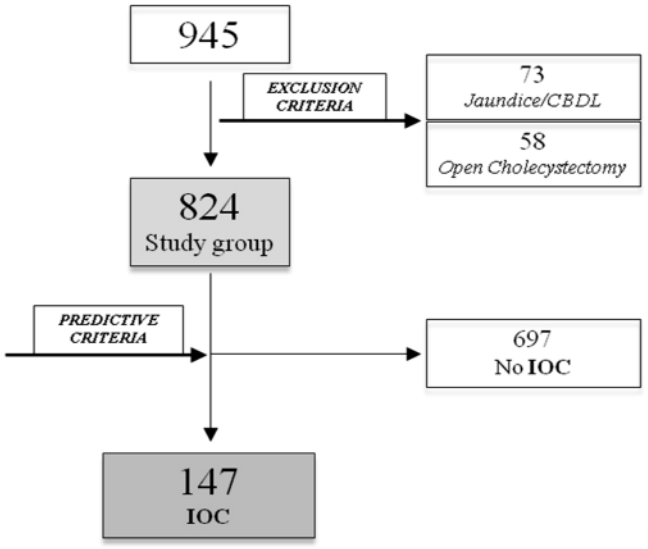

Figure 1. *Study design*

- dilated cystic duct (> 5 mm),
- presence of stones in the cystic duct,
- obvious dilated CBD,
- obscure biliary tree anatomy.

According to the above mentioned criteria, 147 intraoperative cholangiography were performed in a study group of 824 patients that underwent LC. The relevance of this criteria and the outcome of the procedure were retrospectively analysed.

Results

Out of 157 patients that met the above described predictive criteria for IOC, IOC was successfully performed in 147 patients (17.8% from the study group). The median exploration time was 11 minutes, with a variable range between 7 and 18 minutes mostly due to cholangiogram interpretation. In 10 cases IOC was not possible due to the impossible cannulation of the cystic duct.

Intraoperative cholangiography technique

Laparoscopic cholecystectomy was conducted using the standard technique with four ports.After the dissection of Calot's triangle and identification of the cystic artery and cystic duct, the IOC is performed. After applying of a titanium clip distally to the cystic duct close to the infundibulum, a small incision in the cystic duct is made proximally, using laparoscopic scissors. A catheter is inserted into the cystic duct by a grasping forceps through that small transverse incision until its distal hole passes into the lumen and through the Heister's valves, if possible. Initially, the catheter was passed into the peritoneal cavity through an angiocatheter near the midclavicular trocar.The catheter is fixed in place by another titanium clip. After that, the catheter is controlled to be permeable using a 10-ml syringe, and 2 or 3 ml of saline solution is flushed into the lumen to examine the position of the catheter. After making sure that it is water tight, 2 ml of contrast dye is administrated via a syringe into the catheter. A supine image is obtained with a portable radiological unit to visualize distal CBD and Oddi's sphincter. To visualize the proximal CBD, right and left hepatic ducts, and the junction, an additional 5 ml of contrast dye is administered, and the patient is placed in the Trendelenburg position. The laparoscopic CBD exploration was initiated only after it had been verified that no filling defects or injury were present in the CBD. The surgeon is the one who performs, evaluates, and interprets the cholangiogram. Any surgeon who makes a cholangiography should focus on some important findings as anatomic variations, CBD diameter,visualization of the proximal and distal CBD and hepatic ducts, passage of contrast media into duodenum, and the possible presence of the ductal stones.

The maneuver time was measured as the duration between the passing and the extractionof the catheter from the peritoneal cavity. Preoperative antibiotics were administered to all patients and the antibiotic course was not continued postoperatively. All patients attended a focused postoperative surveillance. Some precautions were used in the presence of positive IOC: transcystic drainage, securing cystic duct closure, multiple peritoneal drainage, postoperative abdominal ultrasound and lab tests were performed.

Regarding the 147 cases investigated by IOC, any element that modified the surgical management of the patient from standard LC was considered a positive result.

The results presented in *Table 1* indicate that IOC was positive in approximately 50% of cases. Of these, 51 patients had CBD stones and the rest of 23 patients presented variable modifications: presumed spontaneous passage of stones, stenosing odditis, extrinsic compression, Vaterian ampulloma.

Discussions

Laparoscopy has been shown to offer improved cosmesis, reduced length of in-hospital stay, and more rapid convalescence compared with open cholecystectomy. Nowadays, the vast majorityof cholecystectomies are performed laparoscopically. Of course, there are side effects of this trend. Regrettably, a higher rate of bile duct injury has persisted in the modern era of LC. Recent studies drawing upon large-scale or national database cohorts have reported rates of bile duct injury ranging from 0.2 to 1.1 % (14, 15, 16, 17). Regarding this situation, an expert consensus study was conducted to identify critical factors for safe surgical practice in LC.The experts identified the most important factors relevant to training, assessment, and research for safe practice inLC. (*Table 2*) (18)

Asymptomatic ductal stone means that the patient has no recent history, sonographic evidence, or laboratory tests indicating the presence of ductal obstruction (19). A normal cholangiogram, routinely performed, almost always means a clear bile duct and so it can prevent an unnecessary postoperative ERCP and its potential complications for the symptoms that can be attributed to retained ductal stones (20, 21, 22). Laparoscopic IOC whether used selectively or routinely is safer

Table 1. *IOC Findings*

147 Intraoperative Cholangiography					
73 negative IOC	74 Positive IOC				
	CBD stones	Others situations			
	51 patients	23 patients			
		12 presumed spontaneous passage	2 ampuloma (confirmed on MRI)	7 Oddian stenosis	2 external compression – Mirizzi Syndrome

Table 2. *Dephi expert consensus – importance of IOC*

Critical factor	Delphi round 1			Delphi round 2		Item domain		
	Rating	% ratings 4 or 5	R1 rank	Rating	% ratings 4 or 5	Tech	Non-tech	Peri-op
Establishing the critical view of safety	4.86 ± 0.18	96.9	2	4.83 ± 0.16	99.3	×		
Understanding of relevant anatomy	4.92 ± 0.1	98.7	1	4.93 ± 0.13	98.6		×	
Appropriate intraoperative retraction and exposure	4.77 ± 0.21	98.7	4	4.67 ± 0.25	98.6	×		
Knowing when to call for help (e.g., senior colleague)	4.83 ± 0.17	98.8	3	4.64 ± 0.35	97.8		×	
Recognize need for conversion or alternate procedure	4.74 ± 0.28	96.9	5	4.55 ± 0.31	97.1		×	
Recognize postoperative complications/deviations from expected postoperative course	4.73 ± 0.27	96.2	6	4.57 ± 0.39	96.4			×
Adequate experience of primary surgeon	4.69 ± 0.23	99.4	7	4.31 ± 0.37	92.1		×	
Securing of the cystic duct	4.56 ± 0.35	95.0	11	4.39 ± 0.4	92.1	×		
Appropriate decision to proceed with operation	4.53 ± 0.46	93.8	14	4.32 ± 0.46	89.2		×	
Appropriate use of energy devices by surgeon	4.63 ± 0.36	95.0	9	4.32 ± 0.57	87.8	×		
Surgeon able to perform and interpret intraoperative cholangiography	4.56 ± 0.45	92.5	12	4.34 ± 0.53	87.8	×		
Appropriate tissue handling	4.55 ± 0.42	93.8	13	4.22 ± 0.45	87.8	×		
Appropriate hemostasis	4.56 ± 0.35	96.3	10	4.25 ± 0.48	87.1	×		
Avoidance of injury of right hepatic artery	4.67 ± 0.35	96.3	8	4.22 ± 0.55	82.7	×		
Start dissection of Calot's triangle high on gallbladder	4.39 ± 0.69	86.7	23	4.19 ± 0.76	80.6	×		

Delphi consensus results for factors for safe practice in laparoscopic cholecystectomy, ordered according to importance as determined by final consensus results. Ratings given as mean ± SD

Pucher et al. SAGES expert Delphi consensus 2015

Figure 2. *CBD stones in a 22 year old female patient with laboratory findings of cholestasis. A. Positive IOC; B. rendez-vous ERCP; C. Control IOC after ERCP*

Table 3. *The relevance of predictive factors for selective IOC*

Predictive Factors		Positive IOC (%)
Preoperative	Acute Cholecystitis	9
	History of jaundice	32
	Pancreatitis	22
	Suggestive Symptoms	7
Lab Tests	ALP, GGTP, SGO, SGP	73
Ultrasound	CBD > 6 mm	62
Intraoperative	Dilated cystic duct (>5 mm)	58
	Stones in cystic duct	19
	Obviously dilated CBD	80

than ERCP and more cost effective.

In the earlylaparoscopic era, some authors advocated routine cholangiography during LC despite the acknowledged increase in both operative time and cost. The benefits obtained from clarification of biliary anatomy, detection of cystic and CBD stones, and issues of training may outweigh these disadvantages.Although routine IOC is suggested, careful dissection principles continue to be most important in the prevention of major extrahepatic bile duct injuries during LC.Surgeons must be able to correctly interpret the IOC (23, 24). As we can see in the *Table 2*, the ability of the surgeon to perform and interpret IOC is one of the top five factors relevant both for assessment and research for safe practice in LC.

In this respect, routine versus selective IOC becomes an important subject of discussion.Miron et al performed two prospective studies in 2001 and 2002 in the Department of Surgery of Elias Hospital (one with routine IOC and another with selective intraoperative cholangiograpy) and concluded that IOC was feasible in standard equipment setting but it was encumbered by human and technical limits, recognized by literature and experience (5-10%). Patient selection for IOC using usual criteria was ineffective. In the selective IOC group, the most important intraoperative selection criteria was the cystic duct (dilated > 5 mm, with content) (Miron et al) (25).

The analysis of the predictive factors used for selective IOC indicated a variable relevance between 7% and 80% as indicated in *Table 3*.

As expected, the analysis of preoperative predictive factors indicates that imaging investigations (dilated CBD, dilated extrahepatic bile ducts on abdominal US) and even more so lab tests hold the highest prediction rate. These facts underline the importance of preoperative workup of patients with gallbladder stones, even in the absence of signs of complicated disease. On the other hand, elevated cholestasis enzymes should lead to IOC. Of the clinical predictive factors, history of jaundice was associated in a third of cases with choledocolithiasis. In the current practice of the authors, the LC after an episode of acute pancreatitis demands a radiologic CBD exploration even if the relevance of this predictive factor in the current analysis is relatively low.

Livingston et al studied the indications for selective IOC and they concluded that preoperative identification of a dilated CBD or elevated bilirubin levels can be the sole criteria for performing IOC on a selective basis in patients without malignancy; reliance on traditional indications as a history of remote jaundice, pancreatitis, elevated liver function test values, or pancreatic enzymes results in unnecessary IOCs. (26)

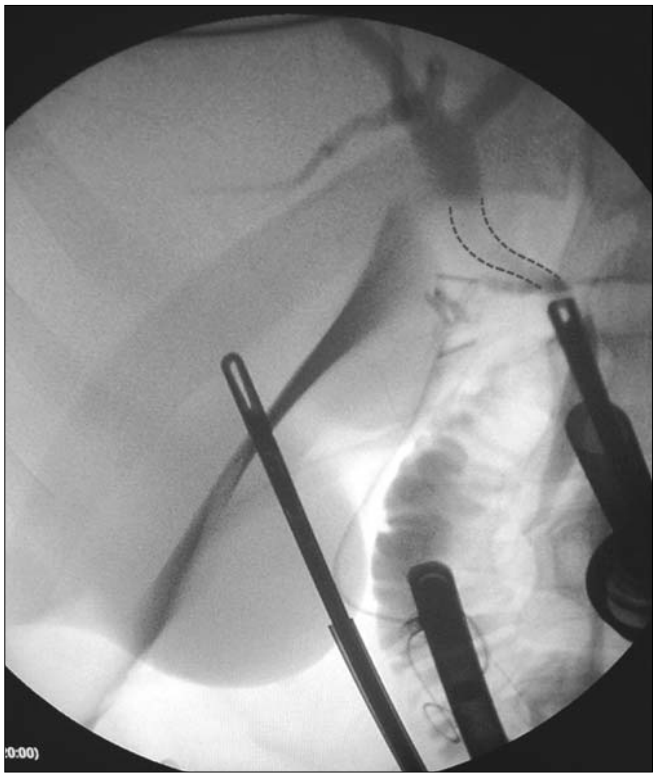

Figure 3. *External compression in a 27 year old patient with an unusual Mirizzi Syndrome*

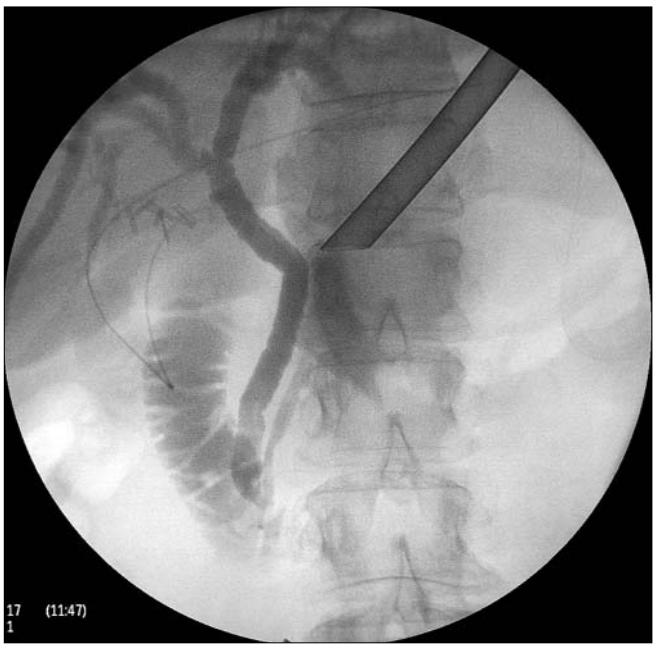

Figure 4. *Negative IOC in a 57 year old female patient with dilated CBD (intraoperative finding)*

Intraoperative exploration is the second essential element in deciding for IOC according to literature data that under-

lines the importance of cystic duct and CBD dilation.

Regarding the results presented in *Table 1*, it is obvious that IOC was positive because it modified the surgical management for 74 patients, representing 50.34% of investigated patients and 8.98% of patients in the study group. Asymptomatic CBD stones were diagnosed in 51 patients, representing 34.69% of investigated patients and 6.18% of patients in the study group. The rest presented either signs of passage of stones, or other modifications, (12 presumed spontaneous passage, 2 Vaterian ampulloma – confirmed postoperatively by cholangioMRI, 7 stenosing odditis and 2 external compression – Mirizzi Syndrome)

These intraoperative findings modified the normal course of LC in different ways. Patients with CBD stones suffered the following additional maneuvers: transcystic stone removal, laparoscopic CBD exploration and stone removal, conversion to open procedure for CBD clearance. For the 12 patients with presumed spontaneous passage of stones and for the 7 patients with stenosing odditis, trancystic drainage was used in 7 cases and the rest underwent abdominal US examinations before discharge. The patients diagnosed with neoplasia suffered consequent pancreaticoduodenectomy in the same admission.

Of the rest of 73 patients with negative IOC, representing 49.65% of the IOC patients and 8.85% of the study group, a single patient was readmitted for jaundice a month after surgery and underwent ERCP.

In terms of detecting bile duct stones, 2-12% of patients will have choledocholithiasis on routine intraoperative cholangiogram (27, 28). A meta-analysis performed in 2004 revealed that the incidence of unsuspected retained stones was 4% with only 15% of these going on to cause clinical problems.The main indications for IOCwere the detection of CBD stones and the definition of biliary anatomy to reduce the incidence and severity of bile duct injury during LC. This meta-analysis concluded that routine IOC yields very little useful clinical information compared with selective policies. Large numbers of unnecessary IOC are performed under routine IOC policy, and therefore an selective policy is advocated (29).

All IOC investigations allowed complete evaluation of biliary anatomy. None of these investigations were employed for the suspicion of CBD injury.

Some other studies have shown that RIOC can detect significantly more biliary injuries as well as unexpected biliary anatomy of potential surgical relevance (30). During the 1990s, a higher rate of iatrogenic biliary tract injuries was reported, and this was attributed to the learning curve for LC. In a review of patients, who were referred to their tertiary center with iatrogenic biliary tract injuries during a 7-year period, Stewart and Way identified the two most important reasons for ductal injury during LC as (a) false identification of CBD as the cystic duct and (b) aggressive efforts to stop bleeding. They outlined liberal use of IOC and cautious interpretationof the lack of opacification of the proximal CBD as a sign of its closure (31).

To resume, using the mentioned criteria a positive IOC was obtained in approximately 50% of cases. As a consequence it can be speculated that in an equal number of cases the investigation would have been done "for nothing". Yet, there were no surgical incidents and the operation was prolonged with only 11 minutes!

There are also arguments that RIOC wastes time and money. It has been estimated that if one severe bile duct injury is prevented in every 1,000 LCs, the cost of all "unnecessary" IOCs will be saved. A cost-effectiveness analysis estimated that RIOC would cost $100 more per LC. However, it would save $390,000 per death avoided and $87,143 per CBD injury avoided (32, 33, 34).

To be honest we could not make such evaluations in our study, but we can estimate that in Romanian current practice the sole expense could be attributed to the contrast dye at variable costs.

Conclusions

Intraoperative cholangiography represents an important tool in diagnosing unsuspected CBD stones duringlaparoscopic cholecystectomy performed either routinely or selectively. Criteria for selective IOC may significantly reduce the number of useless cholangiograms and are to be considered in daily practice.

The main predictive factors used for selective intraoperative cholangiography in our study were: history of jaundice, elevated values of ALP, GGTP, SGO, SGP, and CBD diameter.

Apart from incidental CBD stones, IOC may offer some other details that can modify the course of the patients undergoing laparoscopic cholecystectomy.

References

1. Perissat J. Laparoscopic cholecystectomy. The European experience. Am J Surg.1993;165:444-449.
2. Phillips EH, Berci G. Carroll B, Daykhovsky L, Sackier J, Paz-Partlow M. The importance of intraoperative cholangio-graphy during laparoscopic cholecystectomy. Am Surg. 1990; 56(12):792-795.
3. Maurice E. Arregui, Robert J. Jr. Fitzgibbons, Namir Katkhouda, J. Barry McKernan, Harry Reich. Principles of Laparoscopic Surgery Basic and Advanced Techniques. Springer-Verlag New York Inc. 1995 – Editor's Note
4. Carlson MA, Ludwig KA, Frantzides CT, Cattey RP, Henry LG, Walker AP, Schulte WJ, Wilson SD: Routine or selective intraoperative cholangiography in laparoscopic cholecystectomy. J Laparoendosc Surg. 1993 Feb;3(1):27-33.
5. Flowers JL, Zucker KA, Graham SM, Scovill WA, Imbembo AL, Bailey RW: Laparoscopic cholangiography: results and indications. Ann Surg 1992;215(3):209-216.
6. NIH Consensus Development Panel on Gallstones, Laparoscopic Cholecystectomy (1993) Gallstones and laparoscopic cholecystectomy. Surg Endosc 7: 271-279.
7. Stewart L, Way LW (1995) Bile duct injuries during laparoscopic cholecystectomy. Factors that influence the results of treatment. Arch Surg 130: 1123-1128.
8. Stuart SA, Simpson TI, Alvord LA, Williams MD (1998) Routine intraoperative laparoscopic cholangiography. Am J Surg 176: 632-637.
9. Robinson BL, Donohue JH, Gunes S, Thompson GB, Grant CS, Sarr MG, Farnell MB, van Heerden JA (1995) Selective operative

cholangiography. Appropriate management for laparoscopic cholecystectomy. Arch Surg 130: 625-631.
10. Coppola R, Riccioni ME, Ciletti S, Cosentino L, Coco C, Magistrelli P, Picciocchi A (1997) Analysis of complications of endoscopic sphincterotomy for biliary stones in a consecutive series of 546 patients. Surg Endosc 11: 129-132.
11. Costamagna G, Tringali A, Shak SK, Mutignani M, Zuccala G, Perri V (2002) Long-term follow-up of patients after endoscopic sphincterotomy for choledocholithiasis, and risk factors for recurrence. Endoscopy 34: 273-279.
12. Ammori BJ, Birbas K, Davides D, Vezakis A, Larvin M, McMahon MJ (2000) Routine vs. "on demand" postoperative ERCP for small bile duct calculi detected at intraoperative cholangiography. Clinical evaluation and cost analysis. Surg Endosc 14: 1123-1126.
13. Phillips EH (1993) Routine versus selective intraoperative cholangiography. Am J Surg 165: 505-507.
14. Harboe KM, Bardram L (2011) The quality of cholecystectomy in Denmark: outcome and risk factors for 20,307 patients from the national database. Surg Endosc 25:1630–1641.
15. Waage A, Nilsson M (2006) Iatrogenic bile duct injury: a population-based study of 152 776 cholecystectomies in the Swedish Inpatient Registry. Arch Surg 141:1207–1213.
16. Flum DR, Dellinger EP, Cheadle A, Chan L, Koepsell T (2003) Intraoperative cholangiography and risk of common bile duct injury during cholecystectomy. JAMA 289:1639–1644.
17. Navez B, Ungureanu F, Michiels M, Claeys D, Muysoms F, Hubert C, Vanderveken M, Detry O, Detroz B, Closset J, Devos B, Kint M, Navez J, Zech F, Gigot JF, Belgian Group for Endoscopic S, the H, Pancreatic Section of the Royal Belgian Society of S (2012) Surgical management of acute cholecystitis: results of a 2-year prospective multicenter survey in Belgium. Surg Endosc 26:2436–2445.
18. Pucher PH, Brunt LM, Fanelli RD, Asbun HJ, Aggarwal R. SAGES expert Delphi consensus: critical factors for safe surgical practice in laparoscopic cholecystectomy. Surg Endosc, January 2015, DOI 10.1007/s00464-015-4079-z.
19. Stuart SA, Simpson TI, Alvord LA, Williams MD (1998) Routine intraoperative laparoscopic cholangiography. Am J Surg 176: 632-637.
20. Cuschieri A, Lezoche E, Morinjo M, Croce E, Lacy A, Toouli J, Faggioni A, Ribeiro VM, Jakimowicz J, Visa J, et al. (1999) E.A.E.S. multicenter prospective randomized trial comparing two-stage vs. single-stage management of patients with gallstone disease and ductal calculi. Surg Endosc 13: 952-957.
21. Snow LL, Weinstein LS, Hannon JK, Lane DR (2001) Evaluation of operative cholangiography in 2043 patients undergoing laparoscopic cholecystectomy: a case for the selective operative cholangiogram. Surg Endosc 15: 14-20.
22. Ammori BJ, Birbas K, Davides D, Vezakis A, Larvin M, McMahon MJ (2000) Routine vs. "on demand" postoperative ERCP for small bile duct calculi detected at intraoperative cholangiography. Clinical evaluation and cost analysis. Surg Endosc 14: 1123-1126.
23. Flowers, J.L., Zucker, K.A., Graham, S.M., Scovill, W.A., Imbembo, A.L. and Bailey, R.W., 1992. Laparoscopic cholangiography. Results and indications. Annals of surgery, 215(3), p.209.
24. Woods MS, Traverso LW, Kozarek RA, Donohue JH, Fletcher DR, Hunter JG, Oddsdottir M, Rossi RL, Tsao J, Windsor J. Biliary tract complications of laparoscopic cholecystectomy are detected more frequently with routine intraoperative cholangiography. Surg Endosc (1995) 9:1076-1080.
25. Ulmeanu D, Ardelean M, Calu V, Tatomir A, Teodoru D, Miron A. Limitele colangiografiei intraoperatorii laparoscopice.. Al XXI Congres Național de Chirurgie, Sinaia 2002. Chirurgia 2002, Vol. 97, pag 315, ISSN:1221-9118.
26. Livingston EH, Miller JAG, Coan B, Rege RW. Indications for Selective Intraoperative Cholangiography. Journal of Gastrointestinal Surgery 2005; 9(9):1371–1377.
27. Wenner, D.E., Whitwam, P., Turner, D., Chadha, A. and Degani, J., 2006. Laparoscopic cholecystectomy and management of biliary tract stones in a freestanding ambulatory surgery center. JSLS, Journal of the Society of Laparoendoscopic Surgeons, 10(1), pp.47-51.
28. Lacitignola, S. and Minardi, M., 2008. Management of common bile duct stones: a ten-year experience at a tertiary care center. JSLS, 12(1), pp.62-65.
29. Metcalfe, M.S., Ong, T., Bruening, M.H., Iswariah, H., Wemyss-Holden, S.A. and Maddern, G.J., 2004. Is laparoscopic intraoperative cholangiogram a matter of routine?. The American journal of surgery, 187(4), pp.475-481.
30. Flowers JL, Zucker KA, Graham SM, Scovill WA, Imbembo AL, Bailey RW (1992) Laparoscopic cholangiography. Results and indications. Ann Surg 215: 209-216.
31. Stewart L, Way LW (1995) Bile duct injuries during laparoscopic cholecystectomy. Factors that influence the results of treatment. Arch Surg 130: 1123-1128.
32. Rhodes M, Sussman L, Cohen L, Lewis MP (1998) Randomized trial of laparoscopic exploration of common bile duct versus postoperative endoscopic retrograde cholangiography for common bile duct stones. Lancet 351: 159-161.
33. Robinson BL, Donohue JH, Gunes S, Thompson GB, Grant CS, Sarr MG, Farnell MB, van Heerden JA (1995) Selective operative cholangiography. Appropriate management for laparoscopic cholecystectomy. Arch Surg 130: 625-631.
34. Phillips EH, Berci G, Carroll B, Daykhovsky L, Sackier J, Paz-Partlow M (1990) The importance of intraoperative cholangiography during laparoscopic cholecystectomy. Am Surg 656: 792-795.