Two-year experience with selective intraoperative cholangiography in laparoscopic cholecystectomy

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Background
Intraoperative cholangiography (IOC) during laparoscopic cholecystectomy (LC) is a radiologic contrast-based examination of the bile duct which can represent a systemic approach to clarify biliary anatomy and avoid complications.
Objective
The aim of this study was to evaluate the protective effect of selective use of IOC during LC.
Patients and methods
This study is a prospective study which included 46 patients through 2 years (2017, 2018) who were offered LC, having specific criteria to justify IOC, who underwent LC with IOC. Cases were analyzed as regards operative details and clinical outcomes.
Results
Cholangiography was successfully completed in all the cases. The mean time of IOC added to LC ranged from 15 to 45 min with a mean of 27.39±8.49. There was a longer LC and IOC time in cases with positive C-reactive protein, pericholecystic fluid, mucocele, and pyocele with statistically significant differences. Although the preoperative evaluation showed a history of obstructive jaundice in 47.8% of the cases, and 65.2% had dilated common bile duct, only 13% of the cases showed abnormal IOC which required further therapies (intraoperative endoscopic retrograde cholangiopancreatography in five cases and postoperative in one case); 17.3% of the cases had elevated total bilirubin; 26% of the cases had elevated direct bilirubin; 19.5% of the cases had mucocele; 15.2% of the cases had pyocele; and 30.4% of cases had pericholecystic fluid. No bile duct injuries were reported in our study.
Conclusion
IOC is a safe procedure, adding time of average 27 min to total operative time. IOC is very helpful in cases with suspected choledocholithiasis as it saves the patients unnecessary preoperative endoscopic retrograde cholangiopancreatography. The selective use of IOC can provide critical information about biliary anatomy. The routine use should be abandoned.

Keywords:
intraoperative cholangiography, laparoscopic cholecystectomy, selective

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Introduction

There has been a great debate in the literature regarding the use of routine intraoperative cholangiography (IOC). Those surgeons in favor of this practice have argued that it results in a lower rate of biliary tract injury during cholecystectomy and is a tool for surgical education [1].

Many other surgeons perform cholangiography only in selected patient scenarios. Recent studies have suggested that there is limited benefit to perform routine IOC with every cholecystectomy [2]. Also, there are reports of higher rates of bile duct injuries for surgeons who routinely perform cholangiography as compared with those who only do so selectively [3].

IOC can help to avoid bile duct injury for at least three reasons. First, IOC shows immense diversity of the biliary tree and its patterns of biliary anomalies. Second, a surgeon, over time, becomes an expert on how to read an IOC. The surgeon then is able to discover whether the patient is at risk for biliary injury. Third, if an injury has already occurred, then an IOC can provide early detection and, if correctly interpreted, the injury is not worsened [4].

Aim

The aim of this study was to evaluate the protective effect of selective use of IOC during laparoscopic cholecystectomy (LC).

Patients and methods

This study is a prospective study that was carried out after ethical committee approval in the Gastrointestinal and Laparoscopic Surgery Department at Tanta University Hospitals throughthe years 2017, 2018. The study included 46 patients with accepted written consents who were offered LC having specific criteria justifying IOC including acute cholecystitis, elevated total or direct bilirubin, short or inexistent cystic duct, anatomical variations of biliary system, dilated common bile duct (CBD) preoperatively, and history of obstructive jaundice.

The intraoperative cholangiograms were obtained by a small incision that was made on the cystic duct. A 6 French silicone catheter was used for the cannulation of the cystic duct and injection of diluted contrast material and films were taken (Fig. 1).

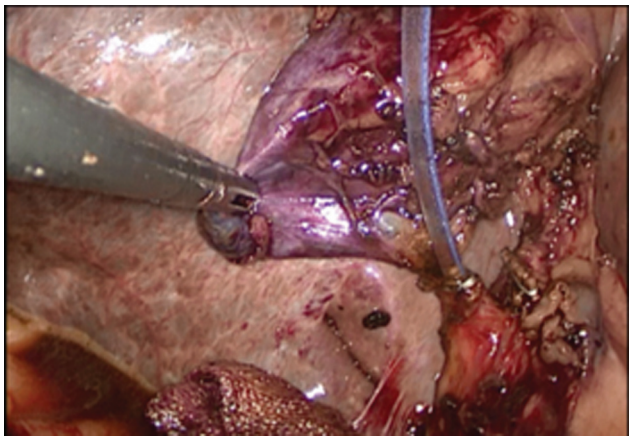
Results

In all, 46 patients were included in the study, 22 patients had a history of obstructive jaundice (47.8%), elevated total bilirubin in six (17.3%) patients, elevated direct bilirubin in 12 (26%) patients, mucocele in nine (19.5%) cases, pyocele in seven (15.2%) cases, pericholecystic fluid in 14 (30.4%) cases, and dilated CBD in 30 (65.2%) cases (Table 1).

Total operative time ranged from 45 to 200 min with a mean of 110.21±43.70.

Cannulation of cystic duct was successful in all cases (100%) IOC time ranged from 15 to 45 min with a mean of 27.39±8.49. It was found that cases with longer operative time showed also long IOC time. This was clear in cases presented preoperatively with positive C-reactive protein with statistically significant difference (P=0.019). It was also noted in cases with ultrasound findings of pericholecystic

Figure 1



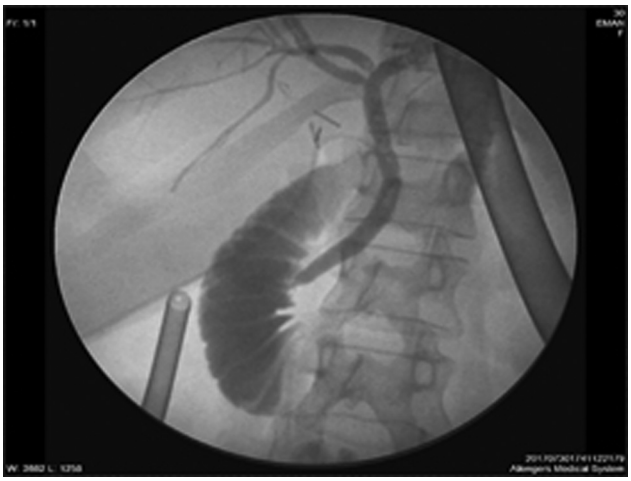
Cholangiography catheter in place.

Table 1 Relation between intraoperative cholangiography findings and different parameters (n=46)

	IOC findings				Test of sig.	p
	Normal (n = 40)		Abnormal (n = 6)			
	No.	%	No.	%		
History of obstructive jaundice						
No	22	55.0	2	33.3	χ^2=0.491	^{FE}P= 0.590
Yes	18	45.0	4	66.7		
Total Bilirubin						
Normal	34	85.0	4	66.7	χ^2=0.610	^{FE}P= 0.453
Elevated	6	15.0	2	33.3		
Min. – Max.	4.70 – 18.0		6.60 – 9.0		U=26.50	0.749
Mean ± SD.	9.09 ± 3.61		7.77 ± 1.20			
Median	8.0	7.70				
Direct bilirubin						
Normal	30	75.0	4	66.7	χ^2=0.094	^{FE}P= 0.616
Elevated	10	25.0	2	33.3		
Min. – Max.	0.20 – 1.70		0.50 – 1.50		U=16.0	0.185
Mean ± SD.	0.75 ± 0.38		0.87 ± 0.55			
Median	0.70	0.60				
CBD						
Normal	16	40.0	0	0.0	χ^2=1.840	^{FE}P= 0.526
Dilated	24	60.0	6	100.0		

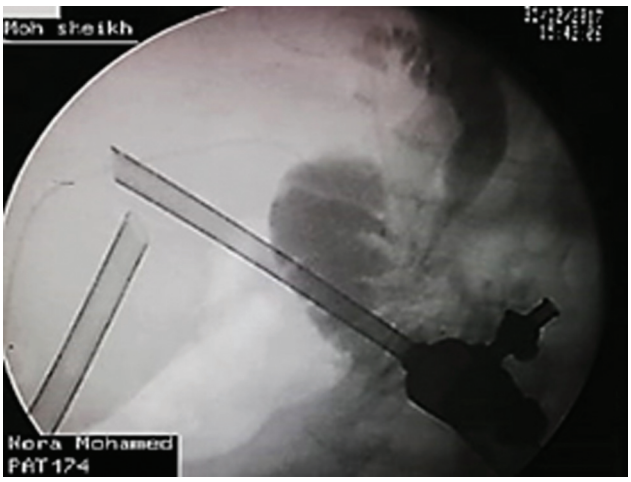
CBD, common bile duct; FE, Fisher exact test; IOC, intraoperativecholangiography; P, P value for association between IOC findings and different parameters; U, Mann–Whitney test. *P≤0.05, statisticallysignificant.

Figure 2



Normal intraoperative cholangiography.

Figure 3



Dilated common bile duct with distal stricture.

fluid, edema, mucocele, and pyocele with statistically significant difference (P=0.029, 0.032, 0.009, 0.048, respectively).

Forty (78%) cases in this study showed correct biliary anatomy, filling of the duodenum without evidence of CBD filling defects (Fig. 2).

Abnormal IOC findings were found in six (13%) cases, two (4.3%) cases showed dilated CBD with distal stricture, in which intraoperative endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy was done with good biliary drainage. (Fig. 3). Four (8.6%) cases showed multiple filling defect with distal CBD stricture, in which intraoperative ERCP with successful sphincterotomy was done with removal of small stones in three cases. ERCP was done in one case, on first postoperative day after LC.

No cases of bile duct injuries was identified intraoperatively or presented postoperatively.

Out of the 24 (52.2%) cases presented with no history of obstructive jaundice, 22 (91.7%) cases showed normal IOC while two (8.3%) cases showed abnormal IOC which required intraoperative ERCP.

Twenty-two (47.8%) cases had a past history of obstructive jaundice, 18 cases of them (81.8%) showed normal IOC findings, while four (18.2%) cases showed abnormal IOC and required ERCP either intraoperatively (three cases) or postoperatively (one case) on the first postoperative day after surgery, thus we preserved 18 patients from unnecessary preoperative ERCP.

It was noted that no cases with normal IOC findings required postoperative ERCP.

Discussion

Whether IOC should be performed routinely or selectively for the prevention of BDIs remains a matter of debate, The SAGES guidelines for the clinical application of laparoscopic biliary tract surgery recommended that IOC may decrease the risk of bile duct injury when used routinely and can allow access to the biliary tree for therapeutic intervention [5]. In a more recent guideline from the European Association for Endoscopic Surgery (EAES), Eikermann *et al.* [6] commented that the routine use of IOC remained controversial and that routine IOC could not be recommend based on the available literature. This guideline, however, indicated that IOC allows for early identification of bile duct injuries as long as they are correctly interpreted [6]. Fletcher commented (if a successful IOC has been performed, the surgeon feels reassured and is in a strong position; on the other hand, CBD injury in a patient who has not undergone IOC may create a medicolegal indefensible situation) [7].

Those with routine use of IOC like Amott *et al.* [8], who performed on the 148 patients in the routine group, 94 underwent IOC and CBD stones were shown in 12. Of the 155 in the selective group, IOC was performed in 34 of 45 eligible patients and stones were shown in five. There was no significant difference in mean operating time (56 vs. 61 min; t-test P=0.15). There was no difference between policies of

routine or selective IOC in relation to operating times, retained CBD stone rates, or CBD injury and thus a policy of routine IOC has been adopted [8]. In Ludwig *et al.* [9], 40 case series comprised 327 523 LCs which were analyzed and determined that there was an association between routine IOC use and a lower incidence of BDIs (0.21 vs. 0.43%) and a higher rate of diagnosis at the time of initial operation (87 vs. 44.5%). Flum *et al.* [10], identified 76 major BDIs out of 30 630 LCs for an overall incidence of 2.5 per 1000 operations; the incidence of BDIs decreased over the time period from 3.2 to 1.7 per 1000 operations. The authors identified a statistically significant 1.7-fold increased relative risk of BDIs when IOC was not used [10].

On the other hand, Ragulin-Coyne *et al.* [3] concluded that routine IOC does not decrease the rate of bile duct injury. The routine IOC group used IOC for 96% of cases, whereas selective IOC group used IOC ~25% of the time. Routine IOC surgeons had no difference in mortality (0.4%) or rate of bile duct injury (0.25 vs. 0.26%), but higher overall complications (7.3 vs. 6.8%, $P = 0.04$). This was associated with significant added cost. Surgeons' routine use of IOC is correlated with increased rates of postsurgical procedures, and is associated with increased overall complications. These data suggest that routine IOC may not improve outcomes [3]. Sheffield *et al.* [2] examined 2000–2013 Texas Medicare data to define the association between IOC use and BDIs and determined that there was no longer an association between IOC use and BDIs. The Ford *et al.* [11] study evaluated eight randomized, controlled trials and did not find any benefit of IOC for the prevention of BDIs.

IOC was used selectively in the current study for patients with specific criteria with risk factors for bile duct injuries; selection criteria were acute cholecystitis, history of obstructive jaundice, ultrasound findings of mucocele, pyocele, increased thickness of gallbladder wall of more than 4 mm or dilated CBD and intraoperative findings of short dilated cystic duct, Mirizzi syndrome, or unclear anatomy. This coincides with the study done by Eikermann *et al.* [6], and this was against another study done by Nuzzo *et al.* [12], which reported 235 BDIs and there were no risk factors for BDIs in 80% of patients.

One argument against the use of IOC has been that it prolongs the duration of LC. In this study, we used a traditional way of 6 French silicone catheter without the use of cholangiography clamp and IOC was successfully completed in all included patients (100%). IOC time ranged from 15 to 45 min with a mean of 27.39±8.49. It was observed that IOC took a longer time in patients operated during an attack of acute cholecystitis. Reports of timing for IOC vary based on the technique, experience with the procedure, and setting. Kumar *et al.* [13] mentioned that the IOC time ranged from 17 to 42 min with a mean time of 24.82 min while Verma *et al.* [14] reported that IOC added an average of 28 min to the total operative time. Buddingh *et al.* [15] reported that IOC time was just over 10 min, while Wenner *et al.* [16] stated that the IOC time ranged only from 2 to 16 min.

In the current study, IOC showed abnormalities in six (13%) cases. 'Interestingly, 65.5% had dilated CBD preoperatively. Out of these 22 cases with a history of obstructive jaundice, 18 cases showed negative IOC and four cases showed positive IOC. This was coincident with other studies done by Verma *et al.* [14], in which IOC showed poor correlation between preoperative suspicion and confirmed CBD stones (two patients only with preoperative suspected CBD stone confirmed on IOC and ERCP). Kumar *et al.* [13] stated that IOC showed normal biliary tree anatomy with free flow of contrast into the duodenum in 87% of cases, while in 13% of cases IOC showed dilated CBD with free flow of the contrast into the duodenum, but with no evidence of filling defects.As regards BDIs, no BDIs occurred in our study, which agrees with the results of Wenner *et al.* [16] and Kumar *et al.* [13], who performed IOC in 52 patients and 100 patients, respectively, and both have no cases of BDIs.

A prospective population-based study of more than 1000 patients by Videhult *et al.* [17] reported that IOC was feasible in 95% of cases and had a sensitivity of 97% and a specificity of 99% for detecting choledocholithiasis With an incidence of 11% of choledocholithiasis in that study. Urbach *et al.* [18] performed a cost-effectiveness analysis comparing four strategies: preoperative ERCP followed by LC, LC with IOC and laparoscopic CBD exploration, LC with IOC and postoperative ERCP, and LC with expectant management. LC with IOC and laparoscopic CBD exploration was the most cost-effective strategy.

Conclusion

IOC is a safe procedure, adding time of average 27 min to the total operative time. It can be helpful in preventing and identifying bile duct anatomy or intraoperative injuries. IOC is very helpful in cases with suspected choledocholithiasis as it saves the patients unnecessary preoperative ERCP.

Whether IOC should be used routinely or selectively, we recommended the selective use of IOC which can provide critical information about biliary anatomy that can be used to guide further surgical therapy and this should be done by expert biliary surgeons only. The routine use should be abandoned.

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Nil.

Conflicts of interest
There are no conflict of interest.

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