

Routine versus selective intraoperative cholangiography during open cholecystectomy?

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In the last 20 years, 3653 patients suffering from biliary calculous disease have been operated on in the Karlovac County General Hospital, 511 (14 %) of them with common bile duct exploration (CBDE). A total of 436 selective Intraoperative Cholangiographies was performed and, on the basis of the obtained results, CBDE was performed in 271 (53 %) cases. Intraoperative cholangiography (IOC) was indicated but not performed in 71 (14 %) cases because of medical, technical and other reasons, mainly subjective. In 47 (9 %) patients CBDE was performed without previous IOC because of clear clinical findings in 112 (24 %) cases, CBDE was performed on the basis of the surgeons's clinical estimation, without IOC. Preoperative and intraoperative criteria were used. The preoperative criteria (CR I) included obstructive jaundice, biliary pancreatitis and cholangitis in recent history as well as positive findings of intravenous biligraphy (IVB) or ultrasonic tomography (UST). The intraoperative criteria included an enlarged CBD, a wide cystic duct or the presence of small multiple stones in the gallbladder. Positive IOC findings occured in 287 (63,5 %) and negative in 141 (33 %) cases. The findings in eight cases were insufficient for analysis. False positive IOC findings occured in 24 (5,2 %) and false negative IOC findings in 22 (5 %) cases of all 436 IOC's. By using selective IOC we recorded 69 (1,7 %) missed stones and 63 (13 %) negative, unnecessary CBDE's. Only one complication in the form of a CBD lesion was recorded. In average, IOC extended operative time for about 30 minutes and increased the operative cost for 62 %.

Key words: cholecystectomy; intraoperative period; intraoperative cholangiography, retained stones, negative common bile duct exploration, criteria

Introduction

In 1932, Mirizzi published his first experiences of intraoperative cholangiography (IOC) used for detecting unsuspected common bile duct (CBD) stones. This method was widely accepted a few decades later. The purpose of IOC was to detect as many unsuspected CBD stones as possible, and to reduce the percentage of unnecessary common bile duct exploration (CBDE).

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The method decreased unnecessary morbidity and mortality due to CBDE and reoperations.^{1,2} In the 1960s, the method was accepted by a great number of surgeons. The increased cost of the procedure, extended operative time, increased danger of possible intraoperative infections, unnecessary exposure to x-ray radiation as well as the need for additional, expensive x-ray equipment were its disadvantages. Because of the above mentioned reasons, a group of surgeons preferred a selective use of IOC.

They reported almost identical results to those obtained by routine IOC.³⁻⁶ The selective use of IOC reduces the total cost of the procedure as well as the above mentioned complications and problems. IOC detects other changes in the CBD as well

as in the papilla Vateri. We use pre-operative and intraoperative criteria. Laparoscopic cholecystectomy tries to maintain all successful intraoperative diagnostic methods confirmed in open cholecystectomy, including IOC. The most recent papers discuss the use of selective IOC during laparoscopic cholecystectomy.⁷⁻⁹

Material and methods

From 1974 to 1994, 3653 patients with calculous biliary disease underwent open cholecystectomy. During the procedure, 511 patients underwent CBDE. Patients with malignant diseases of the biliary tract with or without stones were excluded. IOC was performed in 436 patients on the basis of the preoperative or intraoperative criteria. The mean age of the patients was 56 (18–84). There were 31 % male and 69 % female patients.

The preoperative criteria were determined as follows:

1. *Filling defects and ultrasonic echo in the CBD* were considered as: positive findings as well as a wide CBD with an internal diameter larger than 10 mm.
2. *A wide CBD* with the contrast slowly emptying into the duodenum during *IVB* was considered a positive criteria, too.
3. *Jaundice in recent history*-bilirubin (Bil) > 50 $\mu\text{mol/L}$, alkaline phosphatase (AP) > 100 u/L three months prior to the procedure.
4. *Pancreatitis in history*-data related to biliary pancreatitis a year prior to the operation.
5. *Cholangitis*-biliary colics, fever and transitory jaundice six months prior to the operation.

The intraoperative criteria established on the basis of the intraoperative findings were as follows:

1. *Enlarged CBD* with an external diameter larger than 12 mm. The size of the CBD was determined by means of a 12-mm olive Bakes probe;
2. *Enlarged cystic duct (CD)* with an external diameter larger than 4 mm;
3. *Presence of small stones in the gallbladder*: Small multiple stones were detected either by palpating the emptied gallbladder (needle bile aspiration) or by examining the content of the extracted gallbladder.

In addition to the above mentioned criteria, CBDE with no previous IOC was performed in patients with the following:

1. *Palpable stones in CBD*;
2. *Presence of progressive obstructive icterus* at the time of the operation (Bil > 100 $\mu\text{mol/L}$, AP > 150 u/L);
3. *Enlarged CBD* with an external diameter larger than 15 mm.

In some cases IOC was not performed despite the positive criteria. Technical and medical disadvantages were the main reasons, as well as the fact that, at the beginning, some surgeons in the Hospital refused to accept the procedure. IOC was performed through a square incision on the lateral side of the cystic duct. A polyethylene venous 4–6 F gauge catheter or a metal Storz cannula was inserted. During the examination all unnecessary metal instruments were removed from the operating field. A mobile »SIEMENS« C-arm image amplifier was covered with a special sterile cover. Before the contrast injection the bile tree was flushed with 20–40 ml of warm Normal Saline.

Possible air bubbles were aspirated. The contrast, Telebrix, Biligraphin, Biliscopin, Omnipaque, Ronpacon was diluted to 30 % dilute solution, so that the contrast would not obscure possible small stones. Diascopy was performed with 10 ml of the contrast and the contrast flow was followed through the papilla Vateri. Two films 24 × 30 cm size and additional 20 ml contrast medium was used. While the films were being developed we completed cholecystectomy to shorten operative time. After the examination, the complete sterile operative kit was replaced. The duration of the examination was recorded on an anaesthesiological sheet. The additional costs were calculated on the basis of the cost of x-ray films, contrast medium, syringes, catheters and additional sterile material. The cost of anaesthesia and the medical radiology team's fee were taken into account while the cost of operating theatre and the surgical team's fees were not determined and, therefore, were left out.

Results

Of 3653 patients undergoing cholecystectomy, 436 (12 %) underwent selective IOC. Of 511 CBDEs performed, 271 (53 %) were performed on the basis of positive selective IOC findings.

The number and percentage of the positive and negative IOC findings and the distribution of the false negative and false positive finding are given in Figure 1. In performing selective IOCs we were guided by preoperative and intra operative criteria.

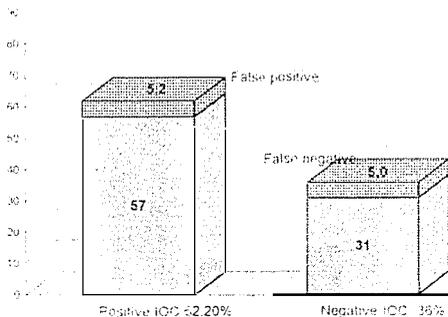


Figure 1. Relations between positive and negative IOC findings. False negative and false positive findings is present too. Eight (1.8 %) insufficient IOCs was insufficient for use.

More than 60 % of the patients fulfilled more than one criterion. In Table I we emphasized only one criterion, the one that had been recorded in the files first. In 22 patients the first criterion was not clearly indicated and in 9 patients IOC was performed on the basis of unknown preoperative criteria. The most common combination not given in

Table I was a wide CBD accompanied by jaundice and/or pancreatitis in history. A positive IVB or UST finding was the most common preoperative criterion used in 37 % (129/350). Over one third of the positive CBDE results was due to pancreatitis. The most common combination of the intraoperative criteria was a wide CD with small stones in the gallbladder. Nevertheless, the most common intraoperative criterion was a wide CBD – 74 % (58/78).

As the paper shows, IOC should have been performed in 71 (14 %) cases, but, because of the reasons mentioned earlier, it was not performed. The results in this group were very bad as shown in Table 2.

The procedure extended operative time for approximately 30 minutes. In cases with a preoperative indication, operative time was extended for a little more than 20 minutes and in the cases with an intraoperative indication, it was extended for more than 45 minutes.

The IOC cost can not be shown in figures in our circumstances, but we have estimated that the cost of cholecystectomy with IOC is 62 % more expen-

Table 1. Preoperative and intraoperative criteria distribution and results of IOC Criteria for IOC.

CRITERIA FOR IOC	IOC	IOC pos (%)	IOC neg (%)	CBDE pos (%)	CBDE neg (%)
Preoperative (CR I)	350	227 (65 %)	123 (35 %)	208 (92 %)	19 (8%)
Positive IVB*	55	34 (62 %)	21 (28 %)	31 (91 %)	3 (9%)
Positive UST*	42	23 (55 %)	19 (45 %)	21 (91 %)	2 (9%)
Positive IVB or UST*	32	26 (81 %)	6 (19 %)	24 (92 %)	2 (8%)
Jaundice	82	63 (77 %)	19 (23 %)	59 (94 %)	4 (6%)
Pancreatitis	85	43 (51 %)	42 (49 %)	40 (93 %)	3 (7%)
Cholangitis	23	17 (74 %)	6 (26 %)	16 (94 %)	1 (6%)
Miscellaneous	22	17 (77 %)	5 (23 %)	13 (76 %)	4 (24%)
Unknown	9	4 (44 %)	5 (56 %)	4 (100 %)	0
Intraoperative (CR II)	78	60 (77 %)	18 (23 %)	56 (93 %)	4 (7%)
Wide CBD > 12 mm	58	47 (81 %)	11 (19 %)	44 (94 %)	3 (6%)
Wide CD > 4 mm	9	7 (78 %)	2 (22 %)	6 (86 %)	1 (14%)
Small stones in	11	6 (55 %)	5 (45 %)	6 (100 %)	0
Total**	428	287 (67 %)	141 (33 %)	264 (92 %)	23 (8%)

IOC – intraoperative cholangyography, CBDE – common bile duct exploration (choledochotomy), IVB – intravenous biliography, UST – ultrasonic tomography, CBD – common bile duct, CD – cystic duct.

* In preoperative calculous biliary disease diagnostics we used IVB till 1984, from 1984 to 1989, the combination of IVB and UST and since 1989 we have been using UST in most cases.

** The quality of 8 IOC's was not suitable for analyses.

Table 2. Retained stones and negative CBDE data.

	Crit I	Crit II	IOC was not necessary	CBDE without IOC	Simple cholecystectom	Total
Cholecystectomy	350	78	47	71	3106	3653
Retained stones	29 (8 %)	4 (5 %)	2 (4 %)	21 (30 %)	13 (0,4 %)	69
Negative CBDE	19 (5 %)	4 (5 %)	3 (6 %)	29 (40 %)	8 (0,25 %)	63
	48 (13 %)	8 (10 %)	5 (10 %)	50 (70 %)	21 (0,65 %)	132

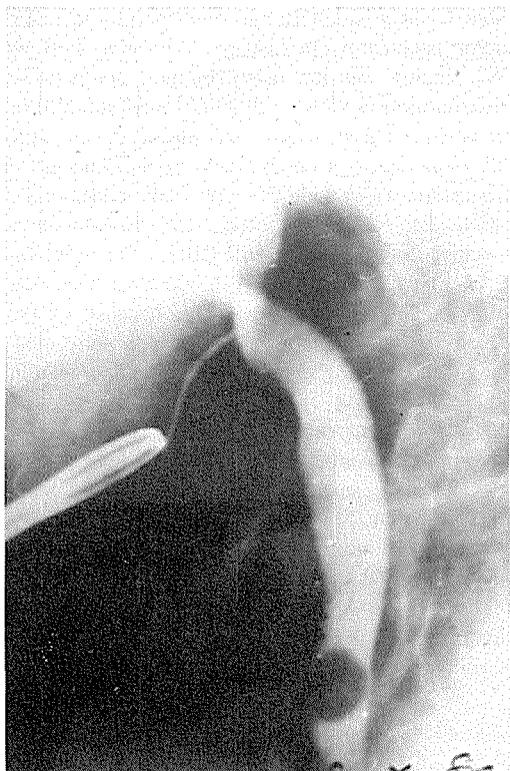


Figure 2a. Prepapillary stone detected by IOC. CBDE was performed, the stone was extracted and T-tube inserted.



Figure 2b. Papillary stenosis with suprapapillary dilatation of the complete biliary tree. Latero-lateral choledochoduodenostomy was performed.

sive than simple cholecystectomy using the points and their value given in the so called »Blue Book«.

Discussion

IOC reduces the number of retained stones as well as the percentage of unnecessary CBDEs. Selective IOC has proved its value in conventional cholecystectomy. Recently, its use has been taken into consideration in laparoscopic cholecystectomy.^{8, 9} CBDE increases morbidity and mortality rate three of four times when compared with simple cholecystectomy.¹⁰⁻²⁰ Stirnemann¹⁴ reports that mortality in biliary reoperations is 8.8 % and in CBDE with cholecystectomy only 2.8 %. Lennert¹⁵ reports two deaths in negative CBDE, and Sheridan et al¹¹ noted 39.3 % complications in the patients who had had negative, unnecessary CBDEs, including two deaths, too.

On the basis of the data given in Table 3 we can see that an attempt to avoid retained stones can

lead to an increased percentage of negative CBDE. In their comparative reports, Clavien and Strassberg¹⁷ using routine IOC report an irrelevant percentage (0.2 %) of retained stones or no stones at all, but their reported negative CBDEs were 27 % and 39 % respectively. Sheridan et al¹¹ reported 2 % retained stones and 22.3 % negative CBDEs respectively. Morgenstern and Berci¹⁶ conclude that 1 % of retained stones at routine IOC is an optimal percentage. On the other hand, Gerber and Apt²¹ showed 500 consecutive cholecystectomies without any IOC. They recorded only one retained stone. Therefore, our results of 1.7 % of retained stones and 13 % of negative CBDE could be considered satisfactory. We have been using the IOC criteria for a long time of which we reported earlier.²² Gregg³ divided the indications of common duct stones into three groups: *minimal* – 4 % of positive findings, *moderate* – 21 positive findings and *maximal* – 91 of positive findings. He has concluded that IOC should be performed in only 7–8 % of patients. Wilson et al⁵ divide cholecystectomies into two

Table 3. References of reported cases in available literature.

Refer	Author	Country	Year	Cholecisec- tomy No.	IOC %	Residual stones %	Negative CBDF %
14	Strinemann	Swiss	1984	346	100	1.2	18.6
16	Morgenstern & Berci	USA	1992	1200	95	0.8	
17	Clavien	Swiss	1992	602	91	0.2	26.8
17	Strassberg	Canada	1992	650	89	0	39.3
19	Den Besten & Berci	International	1986	1072	83	4.5	18.5
20	Moreaux	France	1994	5000	83	1.56	0.5
2	Shively	USA	1990	579	81		21.5
5	Wilson	Austral	1986	272	51	0.36	18
11	Sheridan	United Kingdom	1987	1962	10	1.9	14
3	Gregg Present Report	USA Croatia	1986 1994	1035 3653	1.9 12	2.5 1.7	16.5 13.3

groups: »Would explore« and »Would not explore«. There were 49 % of positive findings in the first group and only 4 % of missed stones in the second group. Pace et al⁶ divide the IOC criteria into CR+ and CR-. They had 95.7 % of normal findings in the CR- group and 71 % of positive findings in the CR+ group. In this way, they avoided unnecessary CBDE in 55 % of patients. The greatest percentage of positive findings (63 %) occurred in the group with an elevated serum Bilirubin level as the criterion, while in the group where the criterion was preoperative cholangitis there were even 82 % of IOC findings. Our results show that preoperative jaundice gave 77 % of positive IOC findings while preoperative pancreatitis gave positive results in only one third of patients and this corresponds with other reports. The most common preoperative criteria are preoperative positive IVB or UST findings.^{23, 24}

In addition to the presence of CBD stones we take into account the internal diameter of CBD too. In our report a wide CBD was criterion in 73 % of cases and filling defects in 70 % of IOCs and in 56 % of CBDEs positive. Although different authors consider an 8–15 mm CBD enlarged, we take a 10 mm internal diameter as a positive preoperative criterion, while a 12 mm external diameter is taken as a positive intraoperative criterion. Intraoperative criteria were determined only in 20 % of cases. Forty-seven (9 %) patients underwent CBD without previous IOC. Twenty-eight (8.5 %) patients had palpable stones in the CBD. Gregg³ palpated only 7 (13.7 %) stones in 51 patients with CBD stones. Stirnemann¹⁴ reports that stones can be palpated only in the middle third of the CBD, the palpation certainty being only 10 %. Our report shows

that in the group of 71 patients where IOC was clinically indicated but not performed, 21 (30 %) retained stones and 29 (49 %) negative CBDEs were recorded. Different authors report different extensions of operative time. Thompson and Bennion report a 7-minute extension of operative time, Gregg a 23-minute, Shively a 10-minute and Paulino-Netto a 27-minute extension of operative time.^{23, 25, 26}

Our results show an average extension of operative time of 30 minutes. The majority of the authors take the age of patients as a positive criterion but we have not noticed any incidence of CBD stones related to the patients' age. The cost of the procedure varies from USD 125 to USD 400 in different authors. Taylor²⁷ states that routine IOC in all cholecystectomies carried out in 1987 would have cost additional 90 million dollars. According to Skilling,²⁸ the cost of one detected unsuspected CBD stone is USD 6,612. According to Gregg,³ 200 cholangiograms and 12 CBDEs have to be carried out to prevent one recurrent stone, at a cost of at least USD 80,000. Pace⁶ reports that 2135 routine IOCs must be performed to detect one unsuspected CBD stone. Our investigation has shown that each IOC increases the cost of simple cholecystectomy for 62 %. If we compare our results with those given in literature we can conclude that we have chosen good criteria for selective IOC. It is a method of choice of intraoperative diagnostics in classical open as well as in laparoscopic cholecystectomy. It decreases the total cost of the procedure giving good results in detecting CBD stones during cholecystectomy. In this way, unnecessary CBDEs, which increase morbidity and mortality rate, are avoided.

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