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Routine or Selective Intraoperative Cholangiography in Laparoscopic Cholecystectomy

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ABSTRACT

The routine versus selective use of intraoperative cholangiography has been the subject of debate for some time. Most authors currently advocate routine intraoperative cholangiography with laparoscopic cholecystectomy. The authors report their experience with the selective and routine utilization of intraoperative cholangiography at two institutions. At institution A, 155 laparoscopic cholecystectomies were attempted, and 21 cholangiograms were performed (based on preoperative criteria of ultrasound, liver function tests, and history of jaundice, or intraoperative anatomical uncertainty). At institution B, 164 laparoscopic cholecystectomies were attempted and 127 cholangiograms were performed (a routine intraoperative cholangiography policy). At institution A, there were no common bile duct injuries but there was one retained stone. At institution B, there was one common bile duct injury and no retained stones. The patient with the retained stone from institution A had a preoperative indication (total bilirubin = 4.4 mg/dl) for a cholangiogram, but it was not performed due to technical difficulties. This patient later required endoscopic sphincterotomy with stone extraction. One patient at institution B had a choledochotomy which was detected by intraoperative cholangiography (IOC). This was managed with a T-tube. The selective use of cholangiograms in laparoscopic cholecystectomy will not yield a higher incidence of common bile duct injuries or retained stones compared to routine use. Further, a cholangiogram may not necessarily prevent choledochotomy but can prevent extension of common bile duct injury. Thus, it should always be performed when there is anatomic uncertainty.

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INTRODUCTION

INTRAOPERATIVE CHOLANGIOGRAPHY (IOC) was introduced in the 1930s.[1] It was employed inconsistently in the 1940s and 1950s, but in the 1960s and the 1970s, its use became commonplace.[2] The rationale for its routine use included: a negative common duct exploration was less likely if the indication for exploration was a positive cholangiogram rather than clinical indications; demonstration of abberant ductal anatomy; avoidance of iatrogenic ductal injury; and detection of common duct stones.[3]

With the advent of laparoscopic cholecystectomy over the past 3 years, there has been continued support for routine IOC.[4–7] The reasoning is similar to that for the open procedure: surgeons want to identify ductal anatomy and common duct stones and avoid common bile duct injury. In general, if choledocholithiasis is found intraoperatively, two options exist: conversion to an open procedure to explore the common duct, or postoperative endoscopic retrograde cholangiography (ERC) with sphincterotomy and stone extraction. Laparoscopic exploration of the common bile duct[8] should be considered experimental. Recent publications suggest that the incidence of common bile duct injuries has been increasing with the advent of laparoscopic cholecystectomy.[9,10] It has been suggested that nonroutine cholangiography increases the risk of common bile duct injury in laparoscopic cholecystectomy; routine cholangiography therefore has been advocated to prevent ductal injuries.

Patients with signs or symptoms of choledocholithiasis or with uncertain anatomy should undergo cholangiography. There is, however, controversy over whether IOC should be performed in those patients without signs or symptoms of choledocholithiasis and with clear anatomy.[11–13] Intraoperative cholangiography adds time and cost to an operation.[14,15] In addition, IOC has a false positive rate of 1–3%, leading to unnecessary biliary explorations[11,16–19] and resulting in increased morbidity and mortality.[2,20] Furthermore, the IOC can result in complications itself.[16,21] In this study, the results of routine versus selective intraoperative cholangiography during laparoscopic cholecystectomy is compared as performed at two institutions.

MATERIALS AND METHODS

At institution A, IOC was performed based on selection criteria, whereas at institution B it was performed routinely. The laparoscopic cholecystectomies were performed by three surgeons at institution A and by two surgeons at institution B. They were performed over a period of 20 and 16 months at institution A and B, respectively. The length of followup was 9–28 months and 16–31 months, respectively.

All patients at institution A had ultrasound performed preoperatively. If common bile duct stones were visualized on ultrasound, the patient underwent preoperative endoscopic retrograde cholangiography (ERC) with sphincterotomy and stone extraction. Serum bilirubin and alkaline phosphatase were assayed preoperatively in all patients. An intraoperative cholangiogram was done if the patient had a history of jaundice, elevated bilirubin or alkaline phosphatase, or preoperative sonographic evidence of common bile duct dilation; or if there was difficulty in identifying the anatomy intraoperatively.

A cholangiogram was performed at institution A by first dissecting a segment of cystic duct. Two clips were placed distally on the cystic duct. An opening was made in the duct just proximal to the clips and away from the cystic-common bile duct junction. Either a conical or balloon tip catheter was introduced into the abdomen via a 14 gauge needle placed through the abdominal wall equidistant to the right midclavicular and subcostal trocars. The conical tip catheter was held in place in the cystic duct by a clip. If a balloon tip catheter was used, the balloon was inflated in the cystic duct. The cholangiogram was filmed with C-arm fluoroscopy. If the study revealed choledocholithiasis or common bile duct obstruction, the laparoscopic procedure was terminated and an open exploration was performed. If the cholangiogram was unremarkable, the cholecystectomy proceeded in the standard fashion using electrocautery. If the patient had a preoperative ERC, cholangiography was not done.

All patients at institution B also had liver function tests and ultrasounds performed preoperatively. As in institution A, patients underwent preoperative ERC if common bile duct stones were visualized on ultrasound.

The technique of laparoscopic cholecystectomy and IOC at institution B was similar to that at institution A, but a Taut cholangiogram catheter was utilized instead of the balloon or the conical tip catheters.

RESULTS

In all, 319 patients underwent laparoscopic cholecystectomies at institutions A (155) and B (164). There were 21 (13.5%) and 127 (77.4%) cholangiograms performed at institutions A and B, respectively. At institution B, 37 patients (22.6%) did not have a cholangiogram because the cystic duct was too small ($n = 29$), or the cholangiogram was not attempted for miscellaneous reasons ($n = 8$). The incidence of retained stones at institution A was 1/155 (0.65%) and 0 at institution B. There was one common bile duct injury at institution B (0.61%) and none at institution A (Table 1).

One patient at institution A had a retained stone. Postoperatively, this patient developed a subhepatic fluid collection which was drained percutaneously. The patient was readmitted 1 week after discharge with abdominal pain. An ERC was performed which revealed a leaking cystic duct stump and choledocholithiasis. Endoscopic sphincterotomy and stone extraction were performed. This patient had a preoperative bilirubin of 4.4 mg/dl. A cholangiogram had been attempted but was unsuccessful due to a small caliber cystic duct.

There was one common bile duct injury at institution B. At operation, the patient's gallbladder was described as shrunken and fibrotic. A structure, identified as the cystic duct, was dissected and a clip was placed proximally. Subsequently, the surgeon demonstrated with a cholangiogram that the structure which had been clipped and entered was the common bile duct. The clip was removed, a T-tube was inserted laparoscopically, and a cholangiogram verified its position; the cholecystectomy was then completed. On postoperative day 1, a laparotomy was performed to replace the T-tube which had become dislodged. Subsequently, the patient did well and at 27 months of follow up is without sequelae.

At institution A, the surgeon's fee for laparoscopic cholecystectomy with and without a cholangiogram was $2248 and $1840, respectively (a difference of $408). The technician's cost for a cholangiogram was $220, the radiologist's fee was $46, and the catheter and dye was $150. Thus, at institution A, the cholangiogram added $824 to the cost of a laparoscopic cholecystectomy. At institution B, the surgeon's fee was $2200 with or without a cholangiogram. The technician's cost was $137, the radiologist's fee was $50, and materials were $23. These charges added $210 to the cost of the procedure.

DISCUSSION

The authors have presented their initial experience with two groups of patients undergoing laparoscopic cholecystectomy in which IOC was utilized either selectively or routinely. Classic indications for exploration of the common duct at 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, or gallstone pancreatitis.[3,22–25] Review of the literature reveals that of the preoperative indications, jaundice, elevated liver function tests, and a dilated/thickened CBD have the highest positive predictive value (40–60%) for choledocholithiasis. These indications were chosen as selection criteria for IOC at institution A. If there was unequivocal evidence of common duct stones on preoperative ultrasound, patients at both institutions underwent endoscopic sphincterotomy and stone

TABLE 1. ROUTINE VS. SELECTIVE IOC

	Laparoscopic Cholecystectomy	*IOC*	*Preoperative ERC*	*Postoperative ERC*	*Retained CBD Stone*	*CBD Injury*
A	155	21(13.5%)	5 (3*)	2 (1*)	1	0
B	164	127(77.4%)	7 (5*)	4 (2*)	0	1

A: Selective cholangiography; B: Routine cholangiography
*Number of procedures which yielded common bile duct stones.

extraction. At institution A, if distorted anatomy was encountered intraoperatively, a cholangiography was performed or laparotomy was undertaken. Following this protocol, there were not any common duct injuries. There was, however, one retained stone in a patient who had an indication for IOC, although it was not performed. This complication is considered preventable.

The cholangiogram added $824 to institution A's cost of a laparoscopic cholecystectomy and $210 to the cost at institution B (not including operating room or anesthesia time). For comparison, Flowers et al[6] calculated that the cost of IOC was an additional $300 (including operating room and anesthesia time). There has been no prospective study that determines the cost effectiveness of routine versus selective cholangiography. Clearly, cholangiography increases the cost of an uncomplicated laparoscopic cholecystectomy.

A central issue regarding the necessity of performing cholangiograms is that of retained stones. Patients with symptomatic common duct stones should have them removed. However, whether an exhaustive search for choledocholithiasis should be made in patients with cholelithiasis is debatable. The answer depends on the percentage of patients undergoing cholecystectomy with clinically silent stones left in the common bile duct who eventually require intervention for retained stones. An autopsy study found a 6.6% incidence of choledocholithiasis in men and 8.7% in women.[26] The number of patients with problematic stones was not reported. The incidence of unsuspected stones in 2,703 routine cholangiograms from 13 reports published from 1961 to 1991 was 3.8%.[3,5,16,17,20,28–35] The fate of nearly all of these stones was immediate removal via duct exploration. This does not, however, answer the pertinent question, what happens if silent common bile duct stones are not removed? This has not been studied prospectively because of the ethical concerns involved with the observation of patients with diagnosed and untreated common duct stones. However, a review of postoperative cholecystectomy patients suggests that approximately 3 in 1,000 patients who did not undergo a procedure to diagnose choledocholithiasis will return in followup with a symptomatic retained stone (Table 2). It is assumed in Table 2 that patients who did not have a diagnostic procedure (either a CBDE or IOC) for common bile duct stones did not have preoperative indications of their presence. By extrapolating this information to institution A, it may be expected that a retained stone will occur only once with every 300

TABLE 2. INCIDENCE OF CHOLECYSTECTOMY PATIENTS WHO DID NOT HAVE AN INTRAOPERATIVE CHOLANGIOGRAPHY (IOC) OR COMMON BILE DUCT EXPLORATION (CBDE) WHO LATER DEVELOPED A RETAINED STONE

Reference	*Total*	*No IOC/CBDE*	*F/U*	*Incidence*
36. Bartlett 1956	1280	1280	N/A	4 (0.31)
28. Madsen 1961	474	160	NA	2 (1.2)
30. Jolly 1968	1460	533	0.2–13	4 (0.75)
37. Cassie 1981	418	357	4–14	1 (0.28)
38. Reasbeck 1981	487	239	3.7	1 (0.42)
12. Gerber 1082	500	438	2–16	1 (0.23)
39. Ganey 1986	1035	745	6	3 (0.40)
40. Grogono 1986	484	330	1–2	1 (0.30)
41. Hauer 1986	457	138	1	0
42. Bogokowsky 1987	505	343	7	1 (0.29)
14. Gregg 1988	765	534	0	0
43. Voyles 1991	453	223	0.75	0
44. Bailey 1992	375	214	N/A	2 (6.9)
18. Pare 1992	1351	525	1	0
TOTALS		6059		20 (0.33)

Total = total number of patients undergoing biliary procedures; No IOC/CBDE = number of patients undergoing cholecystectomy without IOC or CBDE; F/U = length of followup in years; Incidence = number of patients from the No IOC/CBDE column who developed retained stones.

laparoscopic cholecystectomy patients who do not fulfill the selection criteria for a cholangiogram. Whether this can be avoided by performing routine cholangiography and whether it is cost effective cannot be answered by the present study.

An important argument for routine cholangiography in laparoscopic cholecystectomy is that a cholangiogram can prevent common bile duct injury. The authors would like to rephrase this: routine cholangiography may not prevent the initial common bile duct injury (choledochotomy) from occurring, but it may prevent extension (e.g., CBD transection) of that injury. This is illustrated by the common bile duct injury detailed above, in which the surgeon inadvertently entered the duct, but subsequent IOC prevented him from extending a minor injury into a catastrophic one.

With the advent of laparoscopic cholecystectomy, there have been series of laparoscopic cholecystectomy-related common bile duct injury referred to tertiary centers for biliary reconstruction.[9,10,27] Upon review of these cases, some authors have stated that the omission of IOC was a major factor in some of the ductal injuries. They therefore recommend routine cholangiography to prevent common bile duct injury, and also to reveal asymptomatic choledocholithiasis.

Based on the findings of the present study, it is suggested that selective use of IOC based on proper indications does not result in a high incidence of common bile duct injury. It should also be emphasized that common bile duct injury may be avoided by careful and complete dissection of the pertinent anatomic structures, and by utilization of IOC or conversion when anatomic uncertainty exists. Furthermore, IOC may be utilized selectively with an acceptable incidence of retained common bile duct stones.

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