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# Endoscopic retrograde cholangiopancreatography or cholecystectomy first in patients with suspected choledocholithiasis?

A retrospective cohort study of patients with suspected bile duct stones suggests that up-front cholecystectomy, with selective post-op endoscopic retrograde cholangiopancreatography (ERCP), is a safe and cost-effective alternative to routine ERCP.

## ABSTRACT

**Background:** Guidelines concerning the timing of endoscopic retrograde cholangiopancreatography (ERCP) in relation to cholecystectomy for suspected choledocholithiasis are unclear. While some general surgeons suggest ERCP first (EF) prior to cholecystectomy, others suggest cholecystectomy first (CF), with intraoperative cholangiogram and postoperative ERCP as necessary. The aim of this project was to compare outcomes of patients treated with EF versus CF at the Vernon Jubilee Hospital.

**Methods:** Over a 3-year period, a cohort of patients with a diagnosis of cholecystitis, cholangitis, or gallstone pancreatitis and suspected choledocholithiasis were studied. Outcomes were compared between two groups: EF versus CF.

**Results:** During the study period, 205 patients underwent cholecystectomy. Of those, 58 met the inclusion criteria: 37 EF and 21 CF. Those in the CF group had fewer comorbid conditions (1.2 vs 2.2,  $P = .014$ ) and were more likely to have a diagnosis of acute cholecystitis (38% vs 5%,  $P = .0015$ ). Rates of intraoperative complications (CF 0.0% vs EF 10.8%,  $P = .12$ ) and postoperative complications (CF 14.3% vs EF 8.3%,  $P = .47$ ) were similar. Operative time was similar (CF 69.5 minutes vs EF 69.2 minutes,  $P = .98$ ). The hospital length of stay was shorter in the CF group (CF 5.3 days vs EF 7.4 days,  $P = .04$ ). ERCP procedures were avoided in 48% (10/21) of the CF group, and there was a 32% (12/37) rate of nontherapeutic ERCP in the EF group. There were no cases of cystic duct blowout or need for second operation in the CF group.

**Conclusions:** Up-front cholecystectomy in patients with suspected choledocholithiasis with selective post-op ERCP is a safe and cost-effective alternative to routine ERCP in a community hospital setting.

## Background

Gallstone disease develops in 10% to 15% of Caucasian adults and is the consequence of supersaturation of cholesterol in bile.<sup>1</sup> Risk factors include female sex, age over 40 years, obesity, and rapid weight loss. Cholelithiasis,

or gallstones within the gallbladder, is the most common presentation, though 80% of patients are asymptomatic. The risk of developing symptoms is 1.0% to 2.3% per year.<sup>1</sup> The most frequent symptom is biliary colic, classically presenting as postprandial epigastric pain radiating to the back or right shoulder, and is treated by avoidance of lipid-rich foods or elective cholecystectomy. Cholelithiasis can also cause inflammation of the gallbladder (acute cholecystitis), which is treated with emergency cholecystectomy. Gallstones can also migrate from the gallbladder into the bile duct [Figure 1] and cause additional complications, including gallstone pancreatitis when the stones block the pancreatic duct, and cholangitis when bacterial growth accumulates within the bile duct. Common bile duct stones are also referred to as choledocholithiasis.<sup>1-3</sup> Between 5% and 15% of patients with symptomatic cholelithiasis harbor common bile duct stones.<sup>1</sup>

Acute cholecystitis, gallstone pancreatitis, and cholangitis are common reasons for admission to hospital.<sup>1</sup> Cholecystectomy for acute cholecystitis is the second most common emergency general surgery operation after appendectomy. Sometimes these patients present with signs of common bile duct stones with elevated serum bilirubin, elevated liver function

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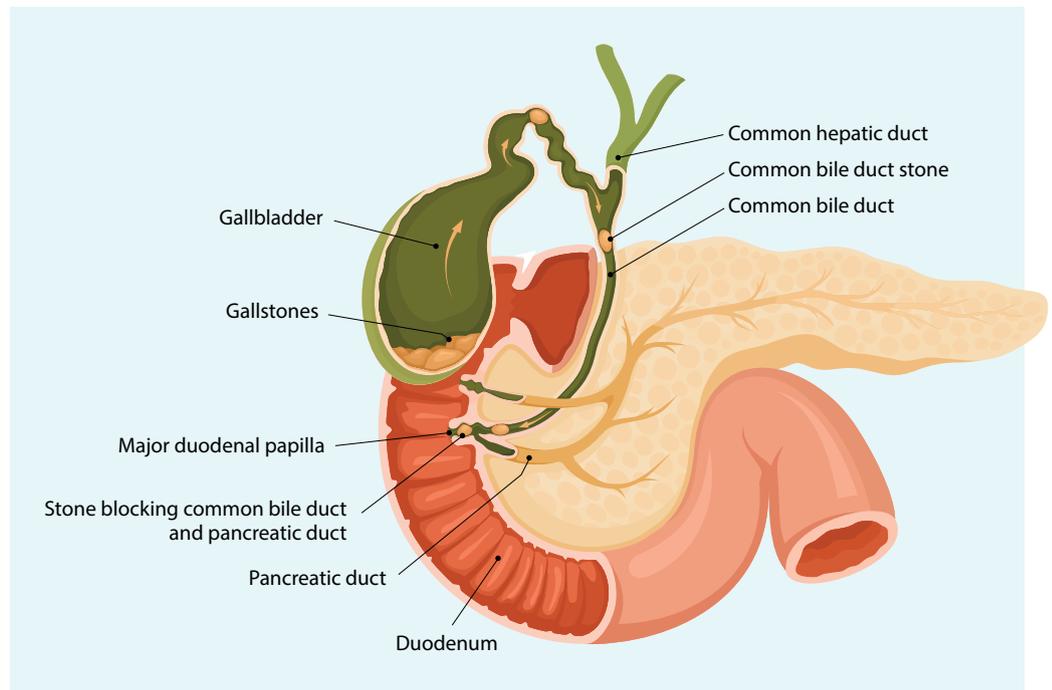
tests, or imaging showing common bile duct dilation.<sup>1</sup> This creates a dilemma whether to clear the common bile duct stones first or perform cholecystectomy first and deal with the common bile duct stones afterward.<sup>1-4</sup>

Patients with a low probability of common bile duct stones are generally recommended to have cholecystectomy, with or without an intraoperative cholangiogram, with selective postoperative endoscopic retrograde cholangiopancreatography (ERCP); those with a high probability of common bile duct stones are recommended to have ERCP first, followed by cholecystectomy.<sup>1-4</sup> Magnetic resonance cholangiopancreatography or endoscopic ultrasound can be helpful to confirm the presence or absence of common bile duct stones.<sup>1,3-5</sup>

In some centres, a single-stage approach with cholecystectomy, intraoperative cholangiogram, and intraoperative ERCP is being offered.<sup>6</sup> In others, laparoscopic common bile duct exploration<sup>1,7,8</sup> or laparoscopic transcystic sphincteroplasty<sup>9</sup> as single-stage options are also being offered. These options are contingent on availability of specialized equipment and technical expertise.

In smaller centres, laparoscopic common bile duct exploration and even ERCP may not be readily available; thus, patients must be transferred to another site. There is growing evidence that undertaking cholecystectomy up front, followed by selective ERCP in patients with suspected common bile duct stones, not only is safe and effective but also reduces hospital length of stay, costs, and need for ERCP<sup>5,10</sup> or endoscopic ultrasound.<sup>5</sup>

Resistance to performing up-front cholecystectomy includes the concern that post-op ERCP may fail to extract the stones and may require a subsequent second operation, though improvements in technology and ERCP techniques, including lithotripsy and choledochoscopy, have made this a rare occurrence; the success rate of postoperative ERCP in clearing stones is 97% to 100%.<sup>1,2</sup> Another concern is that retained stones may increase bile duct pressure and cause a “blowout” of the cystic duct, though this has not been supported by evidence. ERCP requires hospital resources and carries a 6.85% risk of complications, including pancreatitis (3.47%), perforation (0.60%),



**FIGURE 1.** Biliary anatomy.

and ERCP-related death (0.33%).<sup>11</sup> Short of offering a one-stage procedure, up-front cholecystectomy may be a preferable approach if it is safe and effective and reduces the overall need for ERCP.

**There is growing evidence that undertaking cholecystectomy up front . . . not only is safe and effective but also reduces hospital length of stay, costs, and need for ERCP or endoscopic ultrasound.**

Vernon Jubilee Hospital is a regional community hospital in southern British Columbia. It has 196 beds and serves a catchment of more than 125 000 people. Patients require transfer to Kelowna General Hospital (50 km away) for ERCP, which leads to delays in treatment and longer hospital stays. For this reason, some

general surgeons at Vernon Jubilee Hospital have adopted an up-front cholecystectomy approach for patients with suspected common bile duct stones. Anecdotally, this approach has not led to increased complications but has reduced hospital stays and the need for ERCP. The objective of this quality improvement project was to compare outcomes of patients with suspected common bile duct stones treated at Vernon Jubilee Hospital by ERCP followed by cholecystectomy versus up-front cholecystectomy with intraoperative cholangiogram and selective post-op ERCP to confirm or refute these anecdotal impressions.

## Methods

We conducted a retrospective cohort study of adult patients who underwent a cholecystectomy at Vernon Jubilee Hospital in three fiscal years: 2016–2019. Following approval by the Interior Health Research Ethics Board to proceed as a quality improvement project, we identified all patients 18 years or older who had an emergency room visit at Vernon Jubilee Hospital within the previous 6 weeks with a diagnosis of acute cholecystitis, choledocholithiasis, or gallstone pancreatitis, and who underwent cholecystectomy.

**TABLE 1.** Demographic and clinical characteristics.

	Cholecystectomy first	Endoscopic retrograde cholangiopancreatography first	P value
n	21	37	
<b>Patient demographics</b>			
Age (mean)	55.1	63.6	.09
Sex (% female)	43.8	56.3	.26
<b>Comorbidities<sup>†</sup></b>			
Total number (mean)	1.2	2.2	.01
Hypertension (%)	19.0	45.9	.04
Coronary artery disease (%)	9.52	27.00	.11
Diabetes (%)	4.76	16.20	.20
GERD (%)	9.52	27.00	.43
Hypothyroidism (%)	9.52	27.00	.43
Depression/anxiety (%)	9.52	27.00	.92
Smoking (%)	9.52	27.00	.92
Diverticulosis (%)	9.52	27.00	.92
Benign prostatic hypertrophy (%)	9.52	27.00	.92
<b>Laboratory markers<sup>‡</sup> (mean ± SD)</b>			
Bilirubin	63.5 ± 35.0	54.3 ± 30.0	.07
GGT	365 ± 232	455 ± 320	.46
AST	332 ± 209	372 ± 348	.38
ALT	310 ± 250	329 ± 278	.82
ALP	233 ± 95.3	217 ± 56.7	.82
Lipase	13 600 ± 23 400	21 200 ± 28 500	.43
<b>Preoperative diagnosis (number [%])</b>			
Acute cholecystitis	8 (38.1)	2 (5.4)	.002
Choledocholithiasis	6 (28.6)	18 (48.5)	.14
Gallstone pancreatitis	6 (28.6)	12 (32.4)	.76
Ascending cholangitis	0 (0)	4 (10.8)	.12
Mirizzi syndrome	0 (0)	1 (2.7)	.45

ALP = alkaline phosphatase; ALT = alanine aminotransferase; AST = aspartate aminotransferase; GERD = gastroesophageal reflux disease; GGT = gamma-glutamyl transferase.

**TABLE 2.** Surgical outcomes.

	Cholecystectomy first	Endoscopic retrograde cholangiopancreatography first	P value
n	21	37	
Operative time (minutes)	69.5	69.2	.98
Intraoperative complications	0	4	.12
Postoperative complications	3	3	.48
Mean hospital length of stay (days)	5.29	7.39	.04

We included patients who were candidates for ERCP with suspected choledocholithiasis. We excluded patients with uncomplicated biliary colic, chronic cholecystitis, or acute cholecystitis with normal laboratory investigations and no imaging evidence of common bile duct stones or dilation.

We collected information on patient demographics, laboratory markers, operative characteristics, hospital length of stay, and complications. In patients who underwent ERCP, we also recorded whether sphincterotomy was performed, ERCP-related complications occurred, and duct clearance was successful. Patients who may have had post-op complications that presented to another hospital within the Interior Health Authority were captured because there is a common electronic health record system for the whole region.

In comparing patients who received ERCP first (EF) prior to cholecystectomy versus those who received cholecystectomy first (CF), our primary outcomes were mortality and complication rates. Our secondary outcomes included hospital length of stay, surgical time, and non-therapeutic ERCP.

We used the ANOVA test to compare outcomes between the two groups (EF vs CF). We used the Student's *t* test for continuous variables and the chi-square test for categorical variables.

## Results

From April 2016 to March 2019, 205 patients underwent cholecystectomy; 58 patients met the inclusion criteria [Figure 2]. Twenty-one patients (36.2%) had CF; 37 (63.8%) had EF.

Age and sex were similar between the two groups [Table 1]. The mean age of the cohort was 60.5 years, and 56.9% of the patients were females. Compared with patients in the CF group, those in the EF group had a greater total number of comorbidities, and a greater percentage had hypertension. The remaining comorbidities were similar between the two groups. Lab values on presentation were similar between the two groups. More patients in the CF group than in the EF group were diagnosed with acute cholecystitis on admission.

Operative time was similar between the two groups [Table 2]. There were similar rates of

complications in both groups, and there were no deaths in either group.

Among the CF patients, one required conversion to open cholecystectomy due to adhesions, and no patients had intraoperative complications. Three patients had minor post-op complications, including bleeding into the scrotum, hypoxia due to atelectasis, and pain requiring readmission to the emergency department. Of note, none of the CF patients had a post-op cystic duct blowout.

Thirteen of the CF patients (61.9%) had an intraoperative cholangiogram, and 11 (52.4%) had a subsequent ERCP; therefore, ERCP was avoided in 10 patients (47.6%) in this group. Of the 11 patients who required ERCP, 10 had a sphincterotomy and 3 required more than one ERCP to clear all stones, but none required subsequent surgery to do so. There were no notable complications of ERCP in this group.

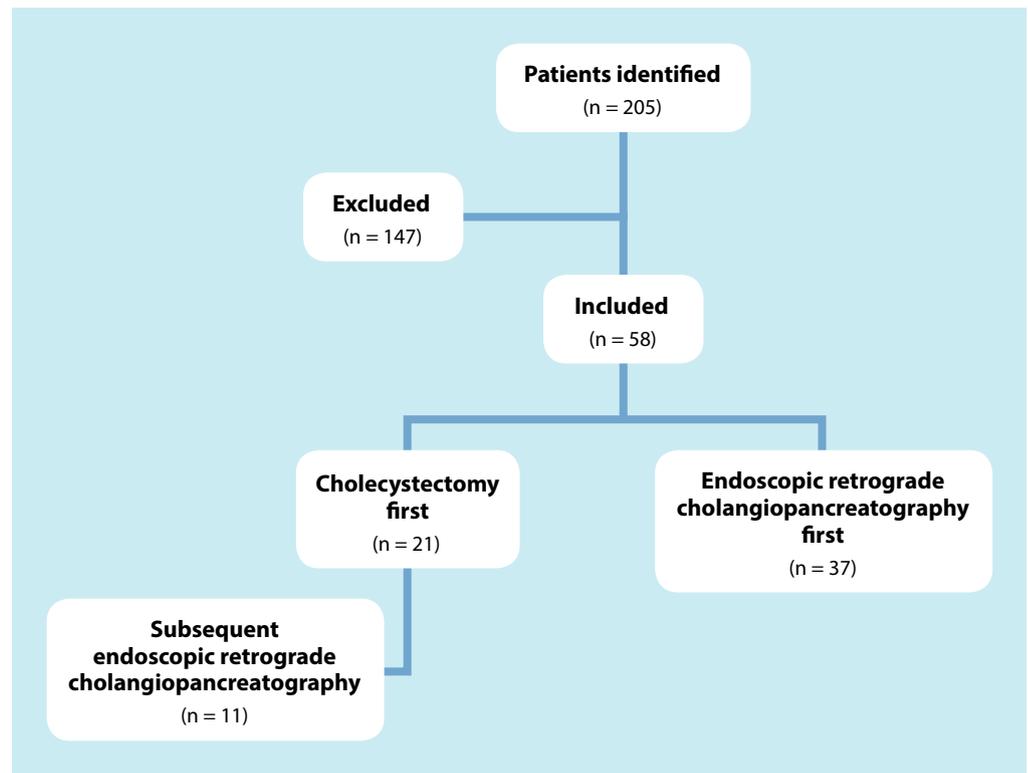
Four of the EF patients had intraoperative complications during cholecystectomy: colon perforation, bleeding, severe cholecystitis requiring bail-out cholecystostomy tube, and bifascicular block. Three EF patients had the minor post-op complication of readmission to the emergency department with pain and/or nausea.

Of the 37 EF patients, 12 (32%) had a non-therapeutic ERCP with no stones found. All 37 patients had a sphincterotomy. During ERCP, one patient had intraoperative bleeding and four required pancreatic stent placement. One patient had a perforation of the intrahepatic duct, which was treated with stenting. One EF patient had failure to clear the stones and was brought back after cholecystectomy for a subsequent ERCP.

Mean hospital length of stay was 2.1 days shorter for CF patients than for EF patients ( $P = .04$ ) [Table 2].

## Discussion

Pressure on health care resources is increasing, with greater demands for all services year over year. In facilities that have equipment and technical expertise to perform laparoscopic common bile duct exploration or intraoperative ERCP as a one-stage procedure, this is likely the most effective choice, with equivalent outcomes to a two-stage approach, demonstrated reduction



**FIGURE 2.** Flow chart of patients included in analysis.

in hospital length of stay, and cost savings.<sup>6-9</sup> However, in our midsized community hospital, laparoscopic common bile duct exploration is not available, and patients must be transferred to the nearest tertiary care centre in Kelowna for ERCP, which justifies a more selective approach. In this setting, performing up-front cholecystectomy saved an average of 2.1 days of hospital stay. This could be explained in part by the fact that almost half the patients did not require ERCP at all; they were simply discharged following cholecystectomy. Other randomized controlled studies also found a CF approach shortened hospital length of stay by 2.7 to 3.0 days and reduced the need for ERCP to 24% to 26%.<sup>5,10</sup>

One-third of the patients in the EF group had no stones found on ERCP yet routinely had a sphincterotomy. This is consistent with the literature, which shows a 40% to 70% rate of a negative ERCP.<sup>1</sup> There is growing evidence that there are long-term consequences to sphincterotomy, including recurrent stones and cholangitis;<sup>12</sup> therefore, it is important to reduce the rate of nontherapeutic ERCP as much as

possible, not just to reduce health care costs but also to prevent these undesirable sequelae. Performing a triage magnetic resonance cholangiopancreatography is one option,<sup>1,4</sup> though it may increase costs by delaying surgery and increasing hospital length of stay in addition to the cost of the investigation itself. We have shown that, in patients with suspected common bile duct stones, an up-front cholecystectomy with intraoperative cholangiogram and selective postoperative ERCP is a safe and cost-effective alternative without needing routine preoperative magnetic resonance cholangiopancreatography, in alignment with previous research on patients with low risk of common bile duct stones.<sup>2</sup>

Over the 3-year period of our review, there were no instances of post-op cystic duct blowout in patients treated with up-front cholecystectomy for suspected common bile duct stones, even though more than half of those patients required ERCP for common bile duct stone clearance. Post-op bile leak is a known complication, even in patients who have pre-op ERCP.<sup>13</sup> Additionally, no patients in the CF group required a second operation, though some

needed more than one ERCP to clear all the stones, which is consistent with the 97% to 100% stone clearance rate in the literature.<sup>2</sup> One patient in the EF group also needed more than one ERCP. Failure of stone clearance has become increasingly uncommon with improvements in ERCP techniques<sup>1,4</sup> and is no longer a reason to perform routine ERCP in all patients with suspected common bile duct stones.

### Study limitations

Limitations of our study include its relatively small size and retrospective design. The CF and EF groups were not equivalent; the EF group had more comorbidities. This may be explained by more patients in the EF group presenting with cholangitis, for which comorbid patients have a higher risk. However, another similar retrospective study that compared CF with EF and excluded patients with cholangitis had similar findings to our study.<sup>14</sup>

### Conclusion

Patients in our study who had up-front cholecystectomy for suspected common bile duct stones with selective postoperative ERCP had satisfactory outcomes and a shorter hospital stay. This is a safe and cost-effective alternative that avoids unnecessary ERCP in one-third to half of patients. Further study is needed to determine whether these findings are applicable to other community hospitals or larger centres. ■

### Competing interests

None declared.

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