



## Predictive Factors for Conversion of Laparoscopic Cholecystectomy

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**Abstract.** Reliable predictive factors for conversion of laparoscopic cholecystectomy (LC) would be extremely useful in the preparation and planning of admission for patients with symptomatic cholelithiasis. Data from 783 patients in whom LC was attempted in a university clinic from June 1990 to December 1995 were retrospectively analyzed. The aim of this study was to determine preoperative indicators that can be useful for predicting conversion to open cholecystectomy (OC). Conversion was required in 58 (7.4%) patients, of which 48 (83%) were elective and 10 (17%) emergency. Factors evaluated were age, sex, obesity, duration of gallstone disease, co-morbid factors, indication for surgery, previous abdominal surgery, fever, physical examination findings, white blood cell (WBC) count, liver function tests, ultrasound findings, and the experience of the surgeon. Acute cholecystitis, rigidity in the right upper abdomen, fever, thickened gallbladder wall on ultrasonography, elevated alkaline phosphatase (ALP), liver transaminases and the WBC count were significant predictors of conversion in the univariate analysis. Multivariate logistic regression analysis on these significant predictors showed that acute cholecystitis [odds ratio (OR) = 3.12], thickened gallbladder wall on ultrasonography (OR = 3.75), elevated ALP (OR = 2.23), and WBC count (OR = 3.69) were jointly significant.

Decreased postoperative pain, shorter hospitalization, earlier return to normal activity, and better cosmesis are well established benefits of laparoscopic cholecystectomy (LC). In addition, studies evaluating physiologic, metabolic, and biochemical responses of the body to LC have confirmed the reduction in trauma from this procedure [1–3]. LC is now accepted as the new gold standard for the treatment of symptomatic gallbladder disease [4].

With growth in experience, criteria for selecting patients for LC have been liberalized. Most of the previous contraindications, such as morbid obesity, previous upper abdominal surgery and acute cholecystitis, are no longer absolute [5–7]. Today, the laparoscopic procedure is attempted in all patients undergoing cholecystectomy except those with portal hypertension and serious bleeding disorders. Conversion from LC to open cholecystectomy (OC) is still required in 1.5% to 19.0% of the patients because of difficulty in delineating anatomy or complications arising during laparoscopic dissection [8–12].

It would be useful to have some reliable predictive factors for conversion or complications in LC. Patients can then be selected for hospital admission or ambulatory surgery, and high risk cases

can be warned of significant chances of conversion and possible complications. The operating team can also be prepared to perform operative cholangiograms or to convert to OC if the need arises. The cost of the operation can be estimated more accurately too. The aim of this study was to determine preoperative indicators that can be useful for predicting conversion to OC.

### Patients and Methods

In the National University Hospital, LC was first performed in June 1990. Preoperative data of 783 consecutive patients who underwent LC between June 1990 and December 1995 were reviewed retrospectively. After the initial learning phase, LC was attempted in all cases.

Preoperative data collected included age, sex, weight, duration of gallstone disease, indication for operation (nonacute or acute symptoms), concomitant medical conditions (ischemic heart disease, chronic obstructive lung disease, diabetes mellitus, pancreatitis, cirrhosis), previous upper or lower abdominal surgery, fever, physical examination findings (tenderness or rigidity in the right upper abdominal quadrant), white blood cell (WBC) count, liver function tests [alkaline phosphatase (ALP), alanine transaminase (ALT), aspartate transaminase (AST), and serum bilirubin levels], ultrasound findings of the gallbladder wall thickness, size and number of stones and common bile duct (CBD), preoperative endoscopic retrograde cholangiopancreatography (ERCP), fever, American Society of Anesthesiology (ASA) classification, and experience of surgeon.

Age was categorized as young (< 65) and old (≥ 65). Body weight of 80 kg and more was categorized as obese. Indication for operation was classified as nonacute disease (asymptomatic gallstone, biliary colic, chronic cholecystitis) and acute disease (acute cholecystitis, empyema) with regard to the clinical presentation. Patients with concomitant choledocholithiasis were classified as either nonacute or acute after stone removal by ERCP. Biochemical analysis of blood was evaluated as normal or abnormal. A gallbladder wall equal to or more than 3.5 mm on ultrasound scanning was evaluated as thick. The number of stones was grouped as single or multiple, and the size of stones was classified as less than 1 cm in diameter or more. Ultrasonographic CBD findings were evaluated in terms of the presence of dilatation and

**Table 1.** Causes of conversion to open cholecystectomy.

| Elective (n = 48, 83%)     |          | Emergency (n = 10, 17%) |         |
|----------------------------|----------|-------------------------|---------|
| Cause                      | No.      | Cause                   | No.     |
| Dense adhesions            | 19 (40%) | Bleeding                | 5 (50%) |
| Friable gallbladder        | 16 (32%) | Common bile duct injury | 5 (50%) |
| Uncertain anatomy          | 4 (8%)   |                         |         |
| Stone in cystic duct       | 2 (4%)   |                         |         |
| Stone in common bile duct  | 2 (4%)   |                         |         |
| Inaccessible gallbladder   | 1 (2%)   |                         |         |
| Failed pneumoperitoneum    | 1 (2%)   |                         |         |
| Thick cystic duct          | 1 (2%)   |                         |         |
| Cirrhosis                  | 1 (2%)   |                         |         |
| Cholecystoduodenal fistula | 1 (2%)   |                         |         |

stones. Fever equal or higher than 38°C was evaluated as high. The experience of the surgeon was classified as “learning” in the first 25 cases and “experienced” if more than 25 cases were performed previously.

The LC was performed using a standard four-puncture technique in all patients. ERCP was performed in selected cases with abnormal liver function tests, jaundice, and ultrasound findings of a dilated CBD (> 6 mm) or CBD stones. LC was performed during the same admission after endoscopic sphincterotomy and stone removal. Intraoperative cholangiography was also performed selectively in patients with uncertain anatomy, suspicion of a CBD stone, or CBD injury.

Postoperative data collected to compare the results of successfully completed cases with converted ones were operative time, postoperative hospital stay, time to resumption of soft diet, complications during the postoperative period and mortality.

### Statistical Analysis

All statistical analyses were performed with the SPSS for Windows version 6.0. In the preliminary analysis, univariate statistical methods were used to determine which preoperative factors were significant for conversion. The chi-square test with Yates' correction or Fisher's exact test was used for categorical variables, and the Student's *t*-test was used for quantitative measurements.

All significant factors from the univariate analysis were subsequently included in the multivariate logistic regression procedure. The FORWARD automatic variable selection procedure was used to determine which of these variables were predictors of conversion. Conversion to open surgery was the dependent variable. Of the 783 patients with missing data, 30 were excluded from the analysis. The missing data were thickness of the gallbladder wall in 2 patients and the ALP level in 28 patients.

### Results

Of the 783 LCs performed by eight surgeons, 274 were men and 509 women (1.0:1.8). The age ranged from 13 to 94 years (mean 51 years). Conversion was required in 58 (7.4%) of cases. The causes and types of conversions are summarized in Table 1. The major causes of conversions were dense adhesions in Calot's triangle or a friable gallbladder. Intraoperative cholangiography revealed CBD stones in two patients. Laparoscopic exploration of the CBD were attempted but failed, and these cases were managed by conventional open technique. Emergency conver-

**Table 2.** Analysis of preoperative parameters for statistical significance.

| Predictors  | Successful (n = 725, %) | Converted (n = 58, %) | Significance |          |          |
|---|-------------------------|-----------------------|--------------|----------|----------|
|   |                         |                       | d.f.         | $\chi^2$ | <i>p</i> |
| Age (years)   |                         |                       |              |          |          |
| ≥ 65  | 624 (86)                | 44 (76)               |              |          |          |
| < 65  | 101 (14)                | 14 (24)               | 1            | 3.688    | 0.054    |
| Sex (female %)                                      | 473 (65)                | 36 (62)               | 1            | 0.118    | 0.73     |
| Obesity (kg)  |                         |                       |              |          |          |
| ≥ 80  | 36 (5)                  | 1 (2)                 |              |          |          |
| < 80  | 689 (95)                | 57 (98)               | 1            | 0.636    | 0.42     |
| Concomitant diseases                                |                         |                       |              |          |          |
| Ischemic heart disease                              | 29 (4)                  | 4 (7)                 | 1            | 0.513    | 0.47     |
| Chronic obstructive lung disease                    | 24 (3)                  | 1 (2)                 | 1            | 0.074    | 0.78     |
| Diabetes mellitus                                   | 53 (7)                  | 3 (5)                 | 1            | 0.117    | 0.73     |
| Pancreatitis  | 23 (3)                  | 2 (3)                 | 1            | 0.013    | 0.90     |
| Cirrhosis   | 7 (1)                   | 1 (2)                 | 1            | 0.305    | 0.58     |
| Previous abdominal surgery                          | 119 (17)                | 5 (9)                 | 1            | 1.897    | 0.16     |
| No. of stones (> 1)                                 | 571 (79)                | 47 (81)               | 1            | 0.067    | 0.79     |
| Size of stones (cm) (≥ 1)                           | 155 (21)                | 14 (24)               | 1            | 0.063    | 0.80     |
| CBD findings on ultrasound                          | 65 (9)                  | 9 (15)                | 1            | 1.983    | 0.15     |
| ASA   |                         |                       |              |          |          |
| I   | 492 (68)                | 41 (71)               |              |          |          |
| II  | 211 (29)                | 14 (24)               |              |          |          |
| III   | 22 (3)                  | 3 (5)                 | 2            | 1.302    | 0.52     |
| Experience (cases)                                  |                         |                       |              |          |          |
| ≤ 25  | 203 (28)                | 22 (38)               |              |          |          |
| > 25  | 522 (72)                | 36 (62)               | 1            | 2.124    | 0.14     |
| Acute cholecystitis                                 | 90 (12)                 | 36 (62)               | 1            | 94.424   | 0.0001   |
| Fever (≥ 38° C)                                     | 108 (15)                | 21 (36)               | 1            | 16.270   | 0.0001   |
| Tenderness and rigidity in right upper quadrant     | 19 (3)                  | 39 (67)               | 1            | 26.282   | 0.0001   |
| Elevated alkaline phosphatase                       | 104 (14)                | 25 (43)               | 1            | 28.217   | 0.0001   |
| Elevated liver transaminases                        | 124 (17)                | 19 (32)               | 1            | 7.438    | 0.0064   |
| Elevated WBC (> 11,000 cells/mm <sup>3</sup> )      | 90 (12)                 | 37 (63)               | 1            | 98.937   | 0.0001   |
| Thickened gallbladder wall on ultrasound (≥ 3.5 mm) | 168 (23)                | 42 (72)               | 1            | 63.575   | 0.0001   |

ASA: American Society of Anesthesiology; CBD: common bile duct; WBC: white blood cell.

sions were required in 10 patients. In five, it was due to bleeding from the cystic artery. Injuries to CBD were the reasons for forced conversions in the other five cases. Two injuries occurred during dissection of acutely inflamed gallbladders and three in chronic cholecystitis. All the complications requiring emergency conversion occurred during learning phase.

### Preoperative Data

Univariate analysis of the preoperative data for statistical significance for conversion is shown in Table 2. Age, sex, obesity, presence of concomitant disease, previous abdominal surgery, elevated serum bilirubin levels, ultrasound findings of CDB, size and number of stones, experience of surgeon, and preoperative ERCP were not statistically significant predictors for conversion. Clinical diagnosis of acute cholecystitis, tenderness and rigidity in the right upper abdominal quadrant, fever, thickened gallbladder

**Table 3.** Jointly significant predictors and the predictive odds ratio of conversion based on the multiple logistic regression model.

| Parameter                                | Odds ratio (OR) | 95% Confidence interval |      | <i>p</i> |
|--|-----------------|-------------------------|------|----------|
| Acute cholecystitis                      | 3.12            | 1.46                    | 6.68 | 0.0033   |
| Elevated alkaline phosphatase            | 2.23            | 1.14                    | 4.36 | 0.0194   |
| Elevated white blood cell count          | 3.69            | 1.76                    | 7.75 | 0.0006   |
| Thickened gallbladder wall on ultrasound | 3.75            | 1.83                    | 7.68 | 0.0003   |

wall on ultrasound scans, and an elevated WBC count and ALT, AST, ALP levels were found to be significant predictors in the univariate analysis even after using the Bonferonni-Holm method to adjust for multiple comparisons. Although the AST and ALT were both significant from univariate analysis, only ALT was chosen for the multivariate analysis because they correlated strongly ( $r = 0.72$ ).

Multivariate logistic regression analysis on the remaining seven variables showed that only four (acute cholecystitis, thickened gallbladder wall on ultrasound scans, elevated WBC count, ALP level) were jointly significant (Table 3).

The probability of conversion is thus:

$$\begin{aligned} \log \text{OR} = & - 4.2149 + (1.1390 \times \text{acute cholecystitis}) \\ & + (1.3227 \times \text{wall thickness}) + (1.3063 \times \text{WBC count}) \\ & + (0.8014 \times \text{ALP}) \end{aligned}$$

in which acute cholecystitis = 1 if present or 0 if absent; gallbladder wall thickening = 1 if 3.5 mm or thicker of 0 if normal; WBC count and ALP = 1 if it is elevated or 0 if normal.

*Postoperative Data*

Operation time was longer in converted cases [mean(SD) of 106(41) minutes versus 71(34) minutes] albeit not statistically significant ( $p = 0.07$ ). Mean hospital stay was significantly longer in converted cases [7.6(2.9) days versus 2.9(2.0) days ( $p < 0.0001$ )]. Time to resumption of soft diet was also longer in converted cases [43(21) hours versus 26(9) hours ( $p < 0.0001$ )].

Wound infection occurred in four (7%) converted patients and six (0.8%) successful patients ( $p = 0.0004$ ). Lung infection occurred in two (3%) converted patients and three (0.4%) successful patients ( $p < 0.04$ ). All responded well to antibiotic therapy. Retained CBD stones were diagnosed postoperatively in two converted and four successful patients ( $p = 0.06$ ). All were cleared by postoperative ERCP. There was one death (0.1%) in the successful group. In that case, an unrecognized CBD transection with intraabdominal bile collection was repaired with hepaticojejunostomy during the early postoperative period, but the patient died from sepsis.

**Discussion**

Clear benefits of LC have rendered it the procedure of choice for symptomatic cholelithiasis. The chance of unwanted “surprises” waiting for surgeon during LC, such as dense adhesions and aberrant anatomy, are the same as those encountered during OC. Thus conversion to OC is inevitable in some cases. If the surgeon

has the benefit of reliable preoperative predictive factors, the chance of conversion can be estimated. The patient can then be informed of this possibility and can be mentally prepared. The patient can adjust his or her expectations accordingly, and unpleasant surprises or the disappointment of a large incision can be minimized. In addition, the well informed patient is able to make necessary contingency arrangements for work and family before surgery.

Today more surgeries are being performed on an ambulatory basis. Arregui et al. reported significantly lower hospital charges due to shorter hospital stay in ambulatory cases [13]. Pain, emesis, and bleeding are the most common causes for unanticipated admission on an ambulatory surgery. Recent developments in general anesthesia specifically applied to LC have allowed more rapid return to normal activities and same-day dismissal [14]. In addition, a remarkable reduction in postoperative pain and a low complication rate has rendered LC a safe, feasible outpatient procedure in the nonrisk group of patients, particularly in busy hospitals with a large volume of patients [13, 15]. Nevertheless, the hospital administration should make arrangements for beds for patients with a high chance of conversion.

Schrenk et al. have analyzed pre- and perioperative risk factors for conversion to OC in 1300 patients and found that rigidity in the right upper abdominal quadrant, thickened gallbladder wall on ultrasound scans, evidence of dense adhesions, and acute cholecystitis were significant indicators for conversion to OC in 56 (4.3%) converted cases [16]. In another study Fried et al. reported 90 (5.6%) conversions to OC among 1676 patients. Age above 65, acute cholecystitis, thickened gallbladder wall on ultrasound scans, obesity, and male sex were determining factors for conversion [17]. In this study, in addition to acute cholecystitis and thickened gallbladder wall on ultrasound scans, we also found an elevated WBC count and ALP level to be significant predictors. These biochemical abnormalities commonly accompany acute inflammation of biliary tree and are indicators of a complicated disease.

To the best of our knowledge, the present study is the first report evaluating predictive factors for conversion to OC in Asian patients. Of 783 patients, 126 (16%) had acute cholecystitis in our series. The conversion rate remained high (28.5%) in the presence of acute cholecystitis despite the increased experience, whereas conversion was required in only 3.4% of the patients with nonacute symptoms. Dense adhesions and edematous, friable gallbladder were the main causes of the high conversion rate in those cases. Difficulty grasping inflamed gallbladders make exposure of Calot’s triangle poor. Another problem interfering with good exposure is dense, highly vascular adhesions in this area. Manipulation often causes bleeding, and visualization may be further hampered. It should be kept in mind that most of the CBD injuries occurred in the is environment [18]. Nevertheless, despite the difficulties encountered during dissection of the acutely inflamed gallbladder, 70% to 94% of these patients can be managed laparoscopically and can thus benefit from better postoperative recovery [19–21]. A low threshold for conversion must be maintained. Instruments necessary for OC and intraoperative cholangiography should always be ready.

By applying the derived formula, the likelihood of conversion can be estimated. A combination of risk factors increases the odds of conversion. A patient with none of the four predictors has a 1.5% of conversion probability, whereas it is 9.3% if acute cholecystitis and elevated ALP are present and 27.5% if acute

cholecystitis, an elevated WBC count, and high ALP level are present. The highest risk group, with all four predictors positive, has a 58.7% conversion rate.

Previous abdominal surgery and obesity were not significant predictive factors. Difficulty arising from thickness of the abdominal wall in obese patients can be overcome with the introduction of extra long trocars. Open insertion of the umbilical ports minimizes the risk of organ injury and allows adhesiolysis in patients with previous abdominal surgery. However, dense adhesions due to previous duodenal ulcer surgery may make dissection of the biliary system difficult. Nevertheless, LC can be attempted. Our overall conversion rate of 9.6% during the learning phase decreased to 6.4% after the first 25 cases. The difference was not statistically insignificant ( $p = 0.14$ ) probably due to our policy of attempting all gallbladders laparoscopically after the learning phase.

Wound infection was significantly higher in the converted group. It probably represents a bias against the converted group, as some of these operations were already complicated by empyema, bile or stone spillage, lengthened operation time, or CBD injury. The rate of lung infection was also higher in converted patients, which may be due to a longer operation time and impaired respiratory function owing to the subcostal incision. Thus patients with strong predictive factors for conversion should be warned of the probability of these complications. Our policy has been to convert if there is no progress in the dissection of the Calot's triangle within 15 to 30 minutes, which probably accounts for the insignificant difference in operating time between successfully completed and converted cases.

Conversion to OC should not be considered a failure but a step toward safety in dealing with challenging cases. Knowledge of predictive factors can be used to plan the type of admission and even to select cases to be done by one or more experienced surgeons. The chance of conversion can also be more accurately conveyed to the patients.

## Résumé

Déterminer les facteurs prédictifs de conversion en chirurgie laparoscopique (CL) serait extrêmement utile dans la préparation et la planification des admissions chez les patients opérés de lithiasc vésiculaire. On a analysé rétrospectivement les données de 783 patients opérés par CL entre Juin 1990 et Décembre 1995 en milieu Universitaire. L'objectif de cette étude a été de déterminer les facteurs prédictifs d'une conversion de CL en chirurgie ouverte (CO). Une conversion a été nécessaire chez 56 (7.4%) des patients, 48 (83%) étant opérés à froid et 10 (17%) opérés en urgence. Les facteurs évalués étaient l'âge, le sexe, l'obésité, la durée de la maladie lithiasique, les facteurs de co-morbidité, l'indication de la chirurgie, la chirurgie antérieure, la fièvre, les données de l'examen physique, le compte leucocytaire, les tests fonctionnels hépatiques, les données de l'échographie et l'expérience du chirurgien. En analyse monofactorielle, la cholécystite aiguë, une défense dans l'hypochondre droit, la fièvre, une paroi vésiculaire épaisse à l'échographie, un taux élevé de phosphatases alcalines (PA), des transaminases et du compte leucocytaire étaient des facteurs prédictifs de conversion. En analyse multifactorielle, la cholécystite aiguë (rapport de côte (RC) = 3.12), une paroi vésiculaire épaisse à l'échographie (RC = 3.75) un taux élevé de PA (RC = 2.23) et un compte leucocytaire élevé (RC = 3.69) étaient des facteurs prédictifs significatifs.

## Resumen

La disponibilidad de factores confiables de predicción de la conversión de la colecistectomía laparoscópica (CL) será extremadamente útil en la preparación y planeación de la admisión de pacientes con colelitiasis sintomática. Se hizo el análisis retrospectivo de los registros de 783 pacientes en quienes la CL fue intentada en un hospital universitario entre julio de 1990 y diciembre de 1995. El propósito del estudio fue determinar indicadores preoperatorios que sean de utilidad en cuanto a predecir la conversión a colecistectomía abierta (CA). Se requirió conversión en 58 pacientes (7.4%), de los cuales 48 (83%) fueron operados en forma electiva y 10 (17%) como urgencia. Los factores evaluados fueron edad, sexo, obesidad, duración de la enfermedad colelitiasica, factores co-mórbidos, indicaciones para la cirugía, cirugía abdominal previa, fiebre, hallazgos en el examen físico, recuento leucocitario, pruebas de punción hepática, hallazgos ultrasonográficos y experiencia del cirujano. En el análisis univariable se hallaron como factores significativos de conversión los siguientes: colecistitis aguda, rigidez en la región superior derecha del abdomen, fiebre, engrosamiento de la pared de la vesícula biliar en la ultrasonografía, fosfatasa alcalina elevada (FAL), transaminasas hepáticas y recuento globular blanco (RGB). El análisis multivariable de regresión logística sobre estos factores significativos demostró que la colecistitis aguda [Riesgo Relativo Indirecto (RRI): 3.12], engrosamiento de la pared de la vesícula biliar en ultrasonografía (RRI: 3.75), FAL elevada (RRI: 2.23) y RGB (RRI: 3.69) fueron conjuntamente significativos.

## Acknowledgment

The authors thank Ms. Pei Yuin for her help in typing this manuscript.

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## Invited Commentary

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Although laparoscopic cholecystectomy (LC) has become the new gold standard for the treatment of symptomatic gallbladder lithiasis, open cholecystectomy (OC) remains mandatory in several situations. This excellent paper by Alponat et al. from the University of Singapore is interesting not only because it analyzes the predictive factors for conversion in LC but also because it attempts to provide a means to identify those patients who are candidates for LC and those who require OC. Assessment in this manner would allow the patient to be informed of the type of surgery prior to operation, the surgeon and operating team could organize a planned procedure, and the health institution could arrange for hospital admission or ambulatory surgery as needed, avoiding unnecessary expenses.

However, this retrospective study does include several sources of bias. Inclusion of the first patients probably increased the conversion rate; thanks to the experience gained, the current rate is probably lower. In addition, the study was limited to gallstones, except for two cases of unsuspected common bile duct lithiasis (CBDL). Finally, the experience of the surgeons (junior or senior) was not well-defined, even though all procedures are known to be surgeon-dependent; this is especially true with laparoscopy.

A number of differences exist between practice as described by Alponat et al., and that at other specialized centers regarding indications, technique, and conversion:

1. *Indications:* All types of symptomatic lithiasis are considered, including CBDL. Indeed, when predictive factors of CBDL are positive (jaundice, abnormal liver function tests, dilated CBD, or CBD stones on ultrasound examination), preoperative endoscopic retrograde cholangiopancreatography (ERCP) is negative in an average of 70% of cases, meaning that most patients undergo unnecessary invasive exploration. When CBDL is detected, pre-operative sphincterotomy is successful 90% of the time, but combined treatment requires 2 procedures and above all 2 anesthetics, except at those centers able to perform peroperative sphincterotomy. One-step treatment is thus currently the routine choice, by clearance of the CBD by the cystic duct when the latter is dilated and stone size is < 5 mm, or else by choledochotomy. At specialized centers, the success rate for stone clearance from the CBD is nearly 100%.

2. *Techniques:* Surgical techniques and imaging studies for control purposes can improve the safety and efficacy of LC. Calot's triangle is usually exposed anteriorly to dissect the cystic structures. This anterior approach involves a risk of arterial and/or biliary injury, and is thus a possible cause for conversion. To avoid anatomical confusion, we recommend the flag technique we described in 1988, which features anterior and posterior dissection of the triangle. This allows the gallbladder to be mobilized like a flag on both sides of its "pole" formed by the CBD, thereby facilitating identification of all anatomic structures. If necessary, antegrade dissection can be performed from the fundus to the infundibulum of the gallbladder, allowing both retrograde (Calot's triangle) and antegrade (fundus approach) control. When the gallbladder is friable, the French technique in which the liver is retracted with a dissector is preferable to grasping the fundus. If the patient is obese or bands cover the hepatic pedicle, addition of one or two trocars facilitates exposure and dissection.

Routine cholangiography is performed first to locate the cystic, the CBD and/or any anatomic abnormalities; this allows safer dissection in case of dense adhesions. Contact ultrasound using a high resolution transducer is helpful for identification of the main bile duct in patients with dense adhesions or acute cholecystitis; similarly, ultrasound combined with color Doppler facilitates recognition of the cystic artery. These techniques reduce the risks of injury due to confusion of anatomic structures; in a prospective study of 1,000 patients managed in this manner, we did not observe any cases of biliary or vascular injury. This global approach to gallbladder and CBD lithiasis improves safety and reduces the risk of injury and therefore the need for conversion. The average conversion rate at most centers today is < 5%.

3. *Conversion.* Conversion to OC should not be considered a failure, as stated by the authors. However, the side effects of open surgery can be minimized by performing a minilaparotomy, then using a suspender, if necessary with traditional instruments, according to the gas-free technique of Mouret, which corresponds to an endoscopically-assisted operation.

In conclusion, this study by Alponat et al., undoubtedly the first conducted in Asian patients, can serve as an example for surgery departments the world over. It accurately analyzes practice at the institution where it was conducted by using an algorithm of indications, surgeon experience, the specific recruitment of patients, and the hospital's economic constraints. Comparison of results from one year to the next should make it possible to refine the indications for LC and improve techniques, results, and training of young surgeons, and therefore reduce the costs of the procedure.