Prediction of conversion of laparoscopic to open cholecystectomy by ultrasonography

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ARTICLE INFORMATION

Pre-operative prediction of a difficult laparoscopic cholecystectomy (LC) can help the patient as well as the surgeon prepare better for the intra-operative risk and the risk of conversion to open cholecystectomy. A prospective study was conducted from December 2008 to September 2010 that included 149 patients who underwent elective laparoscopic cholecystectomy for uncomplicated gallstone disease.

A preoperative gallbladder ultrasonographic evaluation for symptomatic cholelithiasis which documents a thick gallbladder wall (≥3 mm) with calculi, stone, infection and acute cholecystitis are clinical warnings for the laparoscopic surgeon of the potential for a difficult laparoscopic cholecystectomy procedure which may require conversion to an open cholecystectomy. These results demonstrate that conversion to open cholecystectomy can be predicted based on parameters available preoperatively. Improvements in the ability to determine the risk for conversion have important implications for surgical care.

1. Introduction
Gallstone disease occurs in 3% - 20% of the population worldwide. Cholecystectomy remains the most effective treatment for this disease when symptomatic. Laparoscopic cholecystectomy (LC) is the standard procedure for the treatment of symptomatic gallbladder stones. However of all LC’s, 1 – 13% requires conversion to an open cholecystectomy (OC) (Faust et al. 1994; Fried et al. ,1994; Hardy et al. ,1994; Hutchinson et al. ,1994; Leander et al. ,1994; Schrenk et al. ,1995). Advantages of LC include reduced hospitalization, decreased morbidity, short recovery time, and better cosmesis (Daradkeh & Suwan, 1998; Corr et al., 1994; Chumillas et al., 1998; Vittimberga et al., 1998). Patients are informed preoperatively that if intraoperative complications such as uncontrollable bleeding or unclear anatomy, arise, conversion to open surgery will be necessary. It would be helpful to establish a criterion that could assess the risk for conversion preoperatively. The ability to accurately identify an individual patient's risk for conversion based on preoperative information can result in more meaningful and accurate preoperative counseling, improved operating room scheduling and efficiency, stratification of risk for technical difficulty, and appropriate assignment of resident
The dependent variables (outcomes) included the following operative parameters: duration of surgery (in minutes), bleeding during surgery, access to peritoneal cavity, GB bed dissection, intraoperative GB wall thickness, anatomical aberrations, GB injury, stone spillage inside the cavity, difficult extraction, extension of incision for extraction, and conversion to OC. Bleeding during surgery was graded as minimal, moderate or severe. Moderate bleeding was defined as bleeding leading to tachycardia of greater than 100 beats/min without drop in blood pressure (Daradkeh, 1998). Severe bleeding was defined as bleeding leading to tachycardia of greater than 100 beats/min with a greater than 10 mm Hg drop in blood pressure. Duration of surgery included the time from the insertion of the Veress' needle to closure of the trocar site (Corr et al., 1994) and was evaluated as a dichotomous variable (≤60 minutes versus ≥60 minutes). The operating surgeon described the access to peritoneal cavity as 'easy' or 'difficult'. Laparoscopic removal of the gallbladder was attempted in each patient in this clinical series.

2.2 Statistical analysis

Univariate analysis was first performed using the chi squared test to determine the factors that were associated with difficult LC, and odds ratios and their 95% confidence intervals were calculated. Next, a correlation matrix was developed to evaluate correlation between individual predictors. A multiple stepwise logistic regression analysis was then performed using all significant predictors from the univariate analysis and relevant interactions. We used the SPSS statistics version 17.0 software for statistical analysis.

3. Results

Of the 149 consecutive patients who underwent cholecystectomy for symptomatic gallbladder disease, 135 (90.6%) were removed laparoscopically for calculus disease. Fourteen (9.4%) required conversion to an open cholecystectomy (Table 1). Gallstones were found in all patients whose preoperative ultrasound demonstrated gallstones.

In total 59 patients with cholecystitis, 28.8% had acute cholecystitis and 71.2% had chronic cholecystitis as evident on ultrasonographic examination (Table 2). The gallbladder wall was found to be greater than 3 mm in 35.5% of patients with acute calculus cholecystitis and greater than 3 mm in 76.2% of patients with chronic cholecystitis. Seventy six percent of patients who had LC for calculus cholecystitis were females. There was significant difference between acute and chronic cholecystitis with regard to the distribution of the wall thickness. When wall thickness was examined as a function of patient age or sex, the difference was not statistically significant (p<0.1).
Conversion of laparoscopic to open cholecystectomy

Table 1: Relationship of conversion to open cholecystectomy (n=14) with gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total number (n=149)</th>
<th>Converted</th>
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</thead>
<tbody>
<tr>
<td>Males</td>
<td>35</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Females</td>
<td>114</td>
<td>14(12.3%)</td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>14 (9.4%)</td>
</tr>
</tbody>
</table>

Table 2: Thin versus Thick Gallbladder wall in Acute and Chronic Calculous Cholecystitis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thin Walls (&lt;3mm)</th>
<th>Thick Walls (≥3 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute (n=17)</td>
<td>11(64.7%)</td>
<td>6(35.3%)</td>
</tr>
<tr>
<td>Chronic (n=42)</td>
<td>10(23.8%)</td>
<td>32(76.2%)</td>
</tr>
<tr>
<td>Total (n=59)</td>
<td></td>
<td></td>
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</table>

Table 3: Relationship of conversion to open cholecystectomy (n=14) with various parameters on univariate analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholecystitis (n=59)</td>
<td>4.396</td>
<td>1.212 – 15.947</td>
</tr>
<tr>
<td>GB Wall thickness &gt;3mm (n=49)</td>
<td>3.808</td>
<td>1.107 – 13.105</td>
</tr>
<tr>
<td>Contracted GB (n=14)</td>
<td>6.155</td>
<td>1.721 – 22.013</td>
</tr>
</tbody>
</table>

Table 3: Relationship of conversion to open cholecystectomy (n=14) with various parameters on univariate analysis

Forty nine patients, out of a consecutive series total of 149 patients, had a gallbladder wall thickness greater than 3 mm by preoperative sonography (Table 3) and 23(46.9%) of these patients had difficulty in dissection and 10(20.4%) of these patients required conversion to an OC. Conversion to OC in each patient was either due to adhesions, fibrosis, inflammation, bleeding, or edema, which made unequivocal identification of the cystic duct, cystic artery, and CBD not possible laparoscopically.

4. Discussion

Since its introduction in 1989, LC has been regarded as the procedure of choice in the treatment of symptomatic gallstones (Hutchinson et al., 1994; Leander et al., 1994; Dubios et al., 1990). Some of the planned LC have to be converted to OC. It would be useful to know in advance which ones would require conversion.

Biliary tract ultrasonography has proven to be a reliable and accurate diagnostic examination for biliary tract disease. The significant additional ultrasonography information includes thickness of the gallbladder wall, contracted GB or distention, presence of pericholecystic fluid, a sonolucent intraluminal layer, and the diameter of the common duct. A laparoscopic attempt to remove a diseased GB is the current recommendation for cholecystectomy. Conversion from a LC to an OC is an intra-operative decision by the laparoscopic surgeon when visualization and identification of the operative anatomy is impaired by increased vascularity from the inflammatory response, dense adhesions, edema, fibrosis, or abnormal anatomy, such as short cystic duct or an intrahepatic GB.

In our patient population, we noted that the majority (90.6%) of patients with gallstones had an LC. The conversion rate of LC to OC was rather high (9.4%) in our series. One possible explanation for this is that our institution is a tertiary referral and teaching hospital that treats patients with complicated disease. There is a low threshold to convert the laparoscopic approach to open surgery. Our policy is to convert to OC in every case in which the safety of LC is in doubt. These indications include inability to obtain adequate exposure of calot’s triangle, bleeding that cannot be controlled laparoscopically and extensive intra-portal adhesions. This policy has resulted in zero bile duct lesions in these 149 patients.

Preoperative ultrasound measurement of gallbladder wall thickness in this clinical series of 149 LC procedures was of preoperative value for the laparoscopic surgeon and the patient. Of all the 14 patients in this series who required conversion to an OC, 10 patients (71.4%) had a preoperative ultrasound gallbladder thickness of 3 mm and more. Several studies have reported that a thickened GB wall thickness was of little or no benefit in predicting operative technical difficulty or conversion to an OC (Ralls et al., 1981; Martin et al., 1995; Murayama & Thompson, 1996). Several additional clinical studies have reported that a thickened gallbladder wall found by preoperative ultrasonography was associated with an OC OC (Fried et al., 1994; Rosen et al., 2002; Liu CL, Fan et al.,1996; Jacobs et al., 1991).

Plate 1: Trasonographic imaging of GB showing a thickened GB wall along with a hyperechoic lesion casting posterior acoustic shadowing (? calculus).
Several techniques were used to assist with the safe removal of a thick-walled inflammatory GB laparoscopically. Removal of a difficult thick-walled inflammatory GB using the fundus first technique was found to be very useful and helpful to clearly and safely expose the anatomy of the cystic duct, cystic artery, and CBD (Martin et al., 1995; Murayama & Thompson, 1996).

The data from this study demonstrates that preoperative ultrasound examination of the GB, the presence of gallstones, and a GB wall which is 3 mm or thicker in diameter (Plate 1-3) alerts the surgeon of the possibility of a technically difficult LC procedure due to the severity of the inflammatory response. The surgeon should be prepared for possible removal of the gallbladder using the fundus first laparoscopic technique. A second experienced laparoscopic surgeon should therefore be present to assist in operative removal of a GB during a potentially technically difficult laparoscopic procedure. And, the surgeon should be prepared for an early conversion to an OC if the biliary anatomy cannot be accurately identified.

References


