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Gallbladder Nonvisualization in Cholecystectomy: A Factor for Conversion

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ABSTRACT

Background and Objectives: Many risk factors have been identified in minimally invasive cholecystectomies that lead to higher complications and conversion rates. No study that we encountered looked at nonvisualization of the gallbladder (GB) during surgery as a risk factor. We hypothesized that nonvisualization was associated with an increased risk of complications and could be an early intraoperative identifier of a higher risk procedure. Recognizing this could allow surgeons to be aware of potential risks and to be more likely to convert to open for the safety of the patient.

Methods: We looked at minimally invasive cholecystectomies performed at our institution from January 2015 through April 2016 and had the performing resident fill out a survey after the surgery. Outcomes were conversion rates, intraoperative complications, and blood loss and were analyzed via Pearson χ^2 test or Mann-Whitney U test.

Results: The primary outcome showed a conversion rate of 37% in nonvisualized GBs versus 0% in visualized ($P = .001$). Secondary outcomes showed significant differences in GB perforations (74% vs 13%, $P = .001$), omental vessel bleeding (16% vs. 0%, $P = .005$), and EBL (46 mL vs 29 mL, $P = .001$).

Conclusions: Intraoperative nonvisualization of the GB after adequate positioning caused significantly increased risk of intraoperative complications and conversion. This knowledge could be useful during intraoperative assessment, to decide whether a case should be continued as a minimally invasive procedure or converted early to help reduce risk to the patient. Further randomized controlled studies should be performed to further demonstrate the value of this assessment.

Key Words: Conversion to open, Cholecystectomy, Laparoscopy, Gallbladder disease, Surveys and questionnaires.

INTRODUCTION

Since the advent of minimally invasive surgery the preferred approach for a cholecystectomy has changed dramatically. In a relatively short time, laparoscopic cholecystectomy (LC) has become the procedure of choice over open cholecystectomy (OC) for both chronic and acute cholecystitis.[1] At first, this approach was associated with a higher common bile duct (CBD) injury rate compared to the open technique, but as expertise in the field of laparoscopic surgery advanced, the injury rate was quickly reduced. Now LC is commonly performed, with rates of CBD injury as low as 0.3%.[2] Other common complications associated with cholecystectomy include bile leak, wound infection, abdominal abscess, abdominal pain, pulmonary embolism, and myocardial infarction. A systematic review by Coccolini et al[3] showed that multiple endpoints such as morbidity, mortality, length of hospital stay, wound infection, and pneumonia all favored the use of LC over open. None of the endpoints included in the review favored an open cholecystectomy (OC) over LC.[3] Given the decreased morbidities known to be associated with any minimally invasive surgery, the practicing surgeon currently tends to prefer LC whenever feasible. However, trouble arises when there is a reluctance to convert to OC in difficult cases. We found that intraoperative nonvisualization of the gallbladder (GB) after positioning and pneumoperitoneum was associated with higher conversion rates and can be considered a risk factor to encourage earlier conversion, thus potentially reducing complications.

There tends to be a reluctance to convert to OC, as many surgeons feel that converting to a laparotomy will result in more complications than continuing laparoscopically. Many researchers have examined the risk factors associ-

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ated with conversion to OC. Thompson et al[4] looked at 957 patients undergoing either OC, LC with high conversion rate, or LC with low conversion rate. They compared postoperative complication rates and found that there was no statistically significant reduction in complication rate with LC of either high- or low-conversion-rate groups. Their finding suggests that there should be no reluctance to convert to an OC when the case becomes difficult or dangerous.

The question then becomes how we can tell when to switch from LC to OC. Multiple studies have looked at the risk factors involved in conversion rates. In a 14-year analysis, Shamiyeh et al[5] found that some of the key factors for conversion were inadequate creation of pneumoperitoneum, intra-abdominal adhesions, acute cholecystitis, and difficulties in Calot's triangle. Sakpal and colleagues[6] analyzed 2205 LCs and found factors such as male gender, age over 50, and cases performed by low-volume surgeons were associated with a higher conversion rate. Further studies have looked at risk factors that may help the surgeon decide, or at least be aware of the likelihood that they will need to convert to avoid further complications.

Of the many documented preoperative and intraoperative risk factors for conversion, we could find no literature that assesses as a risk factor the nonvisualization of the GB upon entry into the abdomen and after adequate positioning and pneumoperitoneum.[2,4,7] The inability to visualize the GB upon entry may be due to a multitude of factors that independently affect risk of conversion. In all likelihood, a GB that has been acutely inflamed or one that has undergone chronic inflammation for months would be much more difficult to visualize initially. These two risk factors are associated with a high risk for conversion. Other factors, such as an intrahepatic GB, would likely decrease chances of visualization and are also more likely to require conversion to open for a safe operation. Whatever the cause may be for the inability to visualize the GB, there have been no studies that have examined the risk for conversion with this simple assessment performed at the beginning of the laparoscopic procedure.

METHOD

We analyzed LCs performed at Easton Hospital and assessed both visualization and nonvisualization of the GB upon initial entry and after adequate positioning and the subsequent conversion to open. We also factored in urgency of the case, use of the Da Vinci robot, inpatient versus outpatient procedure, and complications that may have happened during the procedure. The dataset included the years in practice of the attending surgeon and the level of postgraduate training of the resident in the case.

Data from 66 cases from January 2015 through April 2016 were compiled for analysis. A survey form was completed by the resident who had performed the surgery with the attending surgeon, as soon as possible after the surgery, to reduce any recall bias. The resident was required to fill out the survey indicating whether the GB was visualized upon positioning and pneumoperitoneum; whether the case was performed laparoscopically or converted to open; and other factors, including timing of the procedure, inpatient versus outpatient, and certain common complications encountered during a cholecystectomy.

We defined visualization of the GB as any portion of the GB being visible after insertion of the laparoscopic camera and creation of pneumoperitoneum with the patient positioned in reverse Trendelenburg with the left side down before any manipulation of intraperitoneal contents. Although most cases of nonvisualization were related to adhesions, we did not evaluate the specific causes (e.g., adhesions or anatomic anomalies) of nonvisualization in each case. Most of the items in the questionnaire were objective (i.e., postgraduate year [PGY], elective vs urgent, and GB perforation) with a few subjective items (i.e., GB bed/fossa bleeding and estimated blood loss [EBL]).

Our primary outcome was the conversion rate in LCs in which the GB was visualized versus LCs in which the GB was not visualized. Secondary outcomes included rates of certain intraoperative complications in relation to visualization and conversion. Other factors included in the analysis consisted of years of practice, PGY level, case urgency, patient location, and EBL.

Most analyses were performed with a Pearson χ^2 test of independence, to determine the relationship between nonvisualization, conversion, the primary outcome, and the secondary outcomes. We analyzed differences in the subset of cases where the GB was not visualized, as well. Given that the data were highly skewed, EBL was analyzed with a Mann-Whitney U test to compare means and medians.

RESULTS

Primary Outcome

Of the 66 LC cases examined, conversion to an open procedure occurred in 7 (36.8%) cases where the GB was

not initially visualized (n = 19), compared to 0% of the cases where the GB was visualized (n = 47; χ^2_1 = 19.37; P = .001). This result suggests an association between initial GB nonvisualization and converting to open cholecystectomy.

Secondary Outcomes

Of the 66 cases, GB perforation occurred in 73.7% of nonvisualized cases versus 12.8% of visualized cases. Bleeding from the omental vessels occurred in 15.8% of nonvisualized cases versus none of the visualized cases (**Table 1**).

Of the 66 cases, 85.7% of GB perforations were associated with cases that were converted, whereas 23.7% were associated with that were completed laparoscopically. One of the 7 converted cases was associated with CBD injury, whereas none of the nonconverted cases was such an injury (**Table 2**).

Of the 19 non-visualized cases, 85.7% of gallbladder perforations were associated with cases that were converted whereas 66.6% were associated with that were completed laparoscopically. Bleeding from the omental vessels occurred in 25% of non-converted cases versus none of the converted cases (**Table 3**).

EBL was higher in the nonvisualized GB group (n = 19; mean, 45.55 mL; median, 25 mL) than in the visualized group (n = 47; mean, 28.63 mL, median, 10 mL) (P = .001). In the same subset, there were significantly higher EBLs in the conversion group (n = 7; mean, 15.50 mL; median, 150 mL) than in the nonconversion group (n = 59; mean, 6.79 mL, and median, 15 mL).

There were significantly more nonvisualized GBs in the urgent than in the elective group—10 (45.5%) versus 9 (19.1%) (P = .023), respectively—and a higher conversion rate—5 (22.7%) versus 2 (4.3%) (P = .018), respectively.

Comparison of inpatient versus outpatient cholecystectomies showed similar, though not statistically significant, trends in nonvisualized inpatient (n = 29) 12 (41.3%) versus outpatient (n = 37) 8 (21.6%) (P .067) and converted inpatient 5 (17.2%) versus outpatient 2 (5.4%) surgeries (P = .107).

Other factors examined, including PGY level, attending years, or practice years, showed no significant difference in conversion or complication rates (**Tables 4** and **5**). However, when PGY level was grouped into higher PGY level—that is, PGY 4/5 compared to PGY 2/3—there was a statistically significant conversion rate of 17.9% versus 0% (P = 0.13) and a nonsignificant difference in the nonvisualized GB group—PGY 2/3, 8 (25.8%) versus PGY 4/5, 7 (17.9%).

DISCUSSION

The use of minimally invasive surgery has become the standard for cholecystectomy because of quick postoperative recovery and visual advantages. As the skill laparoscopic surgery become widespread, most general surgeons have become confident and comfortable in using a minimally invasive technique for procedures such as cholecystectomy. This increase gave rise to a need for objectively assessing which cholecystectomies would be at increased risk for complications during minimally invasive surgery and potentially require conversion to open.

Many studies have demonstrated certain preoperative and intraoperative factors that increase the difficulty of the case and the likelihood for conversion to open.[2,7] At our institution, it was noted that many of the difficult LCs were associated with initial inability to visualize the GB upon creation of pneumoperitoneum after adequate positioning of the patient. We decided to study the association of nonvisualization of the GB on entry and conversion to

Table 1.
Intraoperative Complication Rates of Visualized vs Nonvisualized Groups

Complication, n (%)	Visualized (n = 47)	Nonvisualized (n = 19)	*P*
GB bed/fossa bleeding	7 (14.9)	5 (26.3)	.28
Cystic artery bleeding	2 (4.3)	2 (10.5)	.33
Omental vessel bleeding	0 (0.0)	3 (15.8)	.005
Hepatic artery bleeding	—	—	—
GB perforation	6 (12.8)	14 (73.7)	.001
CBD injury	0 (0.0)	1 (5.3)	.11
Intestinal perforation	1 (2.1)	0 (0.0)	.52

Table 2.
Intraoperative Complication Rates of Converted vs Nonconverted Groups

Complication, n (%)	Converted (n = 7)	Nonconverted (n = 59)	*P*
GB bed/fossa bleeding	2 (28.6)	10 (16.9)	.45
Cystic artery bleeding	0 (0.0)	4 (6.8)	.47
Omental vessel bleeding	0 (0.0)	3 (5.1)	.54
Hepatic artery bleeding	—	—	—
GB perforation	6 (85.7)	14 (23.7)	.001
CBD injury	1 (14.3)	0 (0.0)	.003
Intestinal perforation	0 (0.0)	1 (1.7)	.73

Table 3.
Intraoperative Complication Rates in the Nonvisualized Subset in the Converted vs the Nonconverted Group

Complication	Converted (n = 7)	Nonconverted (n = 12)	*P*
GB bed/fossa bleeding, n (%)	2 (28.6)	3 (25.0)	.87
Cystic artery bleeding, n (%)	0 (0.0)	2 (16.6)	.25
Omental vessel bleeding, n (%)	0 (0.0)	3 (25.0)	.15
Hepatic artery bleeding, n (%)	—	—	—
GB perforation, n (%)	6 (85.7)	8 (66.6)	.36
CBD injury, n (%)	1 (14.3)	0 (0.0)	.18
Intestinal perforation, n (%)	—	—	—

n = 19 nonvisualized GB.

Table 4.
Nonvisualized GBs and Converted Cases in Comparisonto PGY Level

Visualization/Conversion	PGY-2 (n = 12)	PGY-3 (n = 19)	PGY-4 (n = 21)	PGY-5 (n = 18)	*P*
Nonvisualized, n (%)	3 (25.0)	5 (26.3)	5 (23.8)	7 (38.9)	.730
Converted, n (%)	0 (0)	0 (0)	4 (19.0)	3 (16.7)	.100

open. Given the 66 cases in our sample, we found that there is a significant association between initial GB visualization and converting to an open cholecystectomy, suggesting that initial GB visualization is an independent factor in assessing the difficulty of an LC. We also found that nonvisualization was associated with a higher incidence of intraoperative complications, as well as an increased amount of blood loss. Some intraoperative complications showed a statistically significant increase in association with nonvisualization, whereas others showed a trend toward significance although it could not be statistically verified, given our small case sample.

Our study demonstrated an association between visualization of the GB upon pneumoperitoneum and conversion rates. Therefore, if the GB cannot be visualized after adequate positioning of the patient, there is a higher likelihood of converting to an open cholecystectomy. Our secondary outcomes also showed that there is a higher risk of GB perforation when the GB is not visualized initially. All of our secondary outcomes in the nonvisualized group, except for intestinal perforation, showed a higher percentage of intraoperative complications compared to the visualized group although many were not statistically significant.

When we compared our outcomes between cases that were converted and cases that were finished laparoscopically we found that GB perforation and GB bed/fossa

Table 5.
Intraoperative Conversions and Complications in Relation to Attending Years of Practice

Conversions and Complications, n (%)	<5 years (n = 12)	5–15 years (n = 9)	>15 years (n = 47)	*P*
Conversions	1 (8.3)	1 (11.1)	5 (10.6)	.969
Complication				
GB bed/fossa bleeding	3 (25.0)	2 (22.2)	7 (14.9)	.663
Cystic artery bleeding	2 (16.7)	0 (0)	2 (4.3)	.191
Omental vessel bleeding	0 (0.0)	1 (11.1)	1 (2.1)	.276
Hepatic artery bleeding	—	—	—	—
GB perforation	5 (41.7)	3 (33.3)	12 (25.5)	.528
CBD bleeding	1 (8.3)	0 (0.0)	0 (0.0)	.094
Intestinal perforation	0 (0.0)	0 (0.0)	1 (2.1)	.797

bleeding were more common in converted cases. Whether the intraoperative complication happened before or after the conversion was not assessed in this study. Other intraoperative complications were low in frequency and not suggestive of increased likelihood in one study arm versus the other.

Looking at the subset of 19 nonvisualized GBs and, comparing converted versus nonconverted, we sought to identify a difference between complications and EBL. It was our hypothesis that conversion would reduce the risk of complications. Instead, we found that there was a higher rate of GB perforation and CBD injury in the converted group versus the nonconverted one. All other intraoperative complications trended toward the nonconverted, having an increased risk of complications; however, these were not statistically significant, likely because of the small sample. Again, it should be noted that we did not assess any temporal relationship with the intraoperative complications, and so it is unclear whether the complication happened first, followed by the conversion, or vice versa.

Other factors we evaluated such as, elective versus urgent cases, inpatient versus outpatient, PGY level, and attending years of practice showed results similar to what we hypothesized and to results of previous studies. Urgent cases are typically more severe in presentation and onset, leading to a higher likelihood of nonvisualization, the risks associated, and conversion. Inpatient cases showed this trend as well, which was expected, given that most inpatient cases are more likely to be urgent and have other comorbidities at the time of surgery. We found that PGY level and attending years of practice had no relation to conversion rates or complications. When upper PGY levels were compared against lower ones, there was a suggestion of higher nonvisualization and a statistically significant difference in conversion rates, although this outcome was most likely because GBs that are expected to be more difficult preoperatively are often assigned to higher level PGY residents in our institution.

Although one could argue that an increased risk of these intraoperative complications and a slightly higher EBL are not sufficient grounds to decide to convert to open, we believe that this early and objective factor may be the means to begin considering potentially less risky operations in the very sick patient or the patient with many comorbidities. A patient with severe cardiac disease and low hemoglobin to begin with may be worth considering conversion because of the increased risks if the GB is not initially visualized. This factor alone should not be the decisive one for conversion but perhaps should be one of the first intraoperative signs that combine with other intraoperative challenges, such as difficult anatomy or difficulty establishing the critical view of safety to push the surgeon toward conversion. More studies are needed with larger case samples to determine any significant difference between converting to open versus completing the surgery laparoscopically. Determining a temporal relationship between these complications and conversion would also help to show any decrease in complications in a converted procedure. Further study into the cause for intraoperative nonvisualization such as adhesions, anatomical challenges, intrahepatic GB, and others and each one's association with conversion and complications could further define the use of this finding as a risk factor.

In this study, we were able to show a clear association between conversion and nonvisualization of the GB for

LCs. We also showed higher rates of complications and EBL in nonvisualized GBs. Although most surgeons already understand that poor visualization means a more difficult and time consuming surgery, it had not been shown until now that this simple finding also means an increased risk of conversion and complication. Many other complications were suggested between visualization groups and converted groups, but did not show statistical significance, given our smaller subgroups. An objective early factor of GB visualization could easily be used to help in assisting in determining the safest course to take, especially in the high-risk patient.

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