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Factors Affecting Conversion From Laparoscopic Cholecystectomy to Open Cholecystectomy at a Tertiary Care Facility in Saudi Arabia: A Cross-Sectional Study

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Background: Despite the growing importance and increased use of laparoscopy for gallbladder diseases in Saudi Arabia, several factors reportedly result in conversion to open surgery. This leads to increased operative time and increased hospital resource utilization, and, importantly, it impacts patient welfare. Although laparoscopic cholecystectomy and its conversion rates have been investigated in Saudi Arabia, there is little information on the factors associated with this conversion. Therefore, we analyzed the prevalence and factors associated with the conversion from laparoscopic to open cholecystectomy.

Materials and methods: This was a quantitative, retrospective, observational, cross-sectional study. We reviewed the health care records of all patients who underwent laparoscopic cholecystectomy during the study period (January 2014–December 2015). We analyzed patient demographics, preoperative factors, ultrasound findings, and intraoperative factors associated with higher conversion rates. We calculated means, SDs, and medians for numerical variables and percentages and frequencies for nominal variables. The χ^2 and two-tailed *t* tests were used to compare the categorical and continuous

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variables, respectively, between patients who underwent laparoscopic cholecystectomy and those who underwent conversion to open cholecystectomy to analyze their relationship with the possibility of conversion. Statistical significance was considered at $P < 0.05$.

Results: Age > 40 years, diabetes, history of admission for gallstones, and increased total bilirubin, direct bilirubin, and alkaline phosphatase levels were the preoperative factors and adhesions, bleeding, and stone spillage were the intraoperative factors associated with conversion.

Conclusion: Recognizing the factors for conversion would improve treatment planning and help predict when conversion may be necessary.

Key words: Laparoscopy – Cholecystectomy – Conversion to open surgery – Predictive factors

Cholecystectomy is one of the most commonly performed abdominal surgeries. After the introduction of laparoscopic cholecystectomy by Erich Muhe in 1985,[1] laparoscopic cholecystectomy replaced open surgery and became the gold standard for the treatment of symptomatic gallbladder disease. Therefore, its frequency of use has increased in Saudi Arabia and worldwide.[2–6] In comparison to open surgery, laparoscopic cholecystectomy is associated with decreased operative time, decreased postoperative pain, decreased postoperative complications, decreased hospital stay, faster postoperative recovery, and lower morbidity and mortality rates.[7] However, it is also associated with risks, such as intra-abdominal organ injuries, inconvenience during liver retraction, lack of depth perception, difficulty controlling hemorrhage, and decreased tactile discrimination.[3,8]

Nonetheless, conversion from laparoscopic cholecystectomy to open cholecystectomy is sometimes necessary to ensure the success and safety of the procedure. Some studies have shown that certain factors are associated with an increased risk of conversion from laparoscopic to open cholecystectomy. These include preoperative factors such as age, sex, body mass index (BMI) >30, emergency admission, previous abdominal surgeries, history of diabetes, high white blood cell count, high alkaline phosphatase level, high bilirubin level, and signs of acute cholecystitis on ultrasound, and intraoperative factors such as difficulty in defining the anatomy, adhesions, and increased gallbladder wall thickness.[3,9–11]

Although there have been multiple studies on laparoscopic cholecystectomy and its rates of conversion in Saudi Arabia,[5,6,12–14] none of these studies have investigated the factors associated with conversion to open cholecystectomy in Saudi Arabia. This adds to the importance and significance of our study, which aimed to determine the rate of conversion of laparoscopic cholecystectomy to open cholecystectomy at a university teaching hospital in Saudi Arabia and analyzed the factors significantly associated with conversion.

Methods

Study design, setting, and study population

A retrospective review of all patients who had undergone cholecystectomy between January 1, 2014 and December 31, 2015, was conducted to measure the prevalence of conversion from laparoscopic to open cholecystectomy and to determine the factors that contribute to conversion. Patients were identified through the hospital's database. We included all patients who underwent laparoscopic cholecystectomy during the study period. We excluded patients who underwent planned open cholecystectomy and cholecystectomy as part of another procedure. This study was approved by our institutional review board at the College of Medicine, King Saud University. The requirement for informed consent from the patients was waived owing to the retrospective nature of the study.

We reviewed the health care records for the following relevant patient information: patient demographics and medical history (age, sex, BMI, diabetes mellitus, previous abdominal surgery, and previous admission for gallstones); preoperative factors that could contribute to conversion from laparoscopic cholecystectomy to open cholecystectomy (type of admission, temperature, white blood cell count, total and direct bilirubin levels, alkaline phosphatase level, amylase level, date of admission, date of surgery, and length of stay); ultrasound findings, including gall bladder wall thickness,

Table 1 Patient demographics

Variable (n = 589)	n (%)
Sex	
Male	127 (21.6%)
Age, yr	
≥40	288 (48.9%)
BMI	
Obese	311 (52.8%)
Type of admission	
Emergency	121 (20.5%)
Diabetes mellitus	98 (16.6%)
Previous upper abdominal surgery	40 (6.8%)
Previous lower abdominal surgery	123 (20.9%)
Previous admission for gallstones	61 (10.4%)

Obese is defined as BMI > 30.

pericholecystic fluid, sonographic Murphy's sign, and common bile duct diameter; and intraoperative factors, including difficulty delineating anatomy, adhesions, increased gallbladder wall thickness, bleeding, bile spillage, and stone spillage.

Statistical analysis

Statistical analyses were performed using SPSS Statistics for Windows, version 21.0 (IBM Corp, Armonk, New York), and all statistical tests were declared significant at $P \leq 0.05$. We calculated the mean, SD, and median for numerical variables and the percentages and frequencies for the nominal variables.

We used the χ^2 test to compare all categorical variables between patients who underwent laparoscopic cholecystectomy and those who underwent conversion from laparoscopic to open cholecystectomy. We used a two-tailed *t* test to compare the continuous variables between the 2 groups.

Results

We identified a total of 593 patients who underwent cholecystectomy during the study period. Four patients were excluded because cholecystectomy was planned as an open procedure. Of the remaining 589 patients who underwent laparoscopic cholecystectomy, most were women (78.43%) and obese, with a BMI more than 30 (52.8%). Approximately 49% of patients were older than 40 years, and 20% were admitted for emergency cholecystectomy. Table 1 shows patient demographics.

Of the 589 patients, 9 (1.5%) required conversion to open cholecystectomy. Demographics and clinical, ultrasound, and biochemical variables are shown in Table 2. Subjects in the conversion group were mostly men (77.8% versus 20.7%; $P < 0.001$), and they were significantly older than those in the laparoscopic group (88.9% versus 48.3% older than 40 years; $P = 0.016$). Fewer patients in the conversion group were obese patients (BMI > 30) compared with those in the laparoscopic group (22.2% versus 53.3%, $P = 0.06$), but this was not statistically significant. The operative time was longer for subjects in the conversion group (198.7 ± 69.4 versus 87.4 ± 41.0 minutes; $P < 0.001$). In addition, the number of days between admission and surgery (5.1 ± 5.3 versus 1.3 ± 1.9; $P = 0.04$), number of days between operation and discharge (12.1 ± 11.0 versus 1.2 ± 2.6; $P < 0.001$), and the overall total hospital stay (17.2 ± 12.0 versus 3.1 ± 6.0; $P < 0.001$) were significantly higher for the conversion group.

There was no significant relationship between the possibility of conversion in terms of the following factors: previous upper or lower abdominal surgery, white blood cell count, maximum body temperature, or common bile duct diameter on ultrasound. However, previous admissions for gallstones, total bilirubin, direct bilirubin, and alkaline phosphatase were significant factors. Patients in the conversion group were more likely to have a history of admission for gallstones (33.3% versus 10.34%; $P = 0.027$). Total bilirubin (57.5 ± 69.3 versus 15.7 ± 32.9; $P < 0.001$), direct bilirubin (47.8 ± 64.7 versus 8.8 ± 25.9; $P < 0.001$), and alkaline phosphatase (470.3 ± 399.5 versus 128.5 ± 94.9; $P < 0.001$) levels were significantly higher in patients who required conversion. Diabetes mellitus was more common in the conversion group (66.7% versus 15.9%; $P < 0.001$). Adhesions (88.9% versus 21.4%, $P < 0.001$), bleeding (22.2% versus 4.1%, $P = 0.008$), and stone spillage (22.2% versus 5.2%, $P = 0.03$) were significantly more frequent in the conversion group (Table 3). However, unclear anatomy, thick gallbladder wall, and bile spillage had no significant relationship with conversion of laparoscopic to open cholecystectomy.

Discussion

In this study, we examined the rate of conversion from laparoscopic to open cholecystectomy and the factors associated with conversion. Nine patients (1.5%) required conversion from laparoscopic to open cholecystectomy. The rate of conversion to open cholecystectomy in our study was lower than rates described in reports of studies performed worldwide, including others performed here in

Table 2 Comparison of demographic, clinical, ultrasound, and biochemical variables between the laparoscopic and conversion groups

Variable	LC (n = 580)	CTO (n = 9)	*P*
Sex, n (%)			
Male	120 (20.7%)	7 (77.8%)	<0.001[a]
Age, yr (n (%)			
≥40	280 (48.3%)	8 (88.9%)	0.016[a]
BMI, n (%)			
Obese	309 (53.3%)	2 (22.2%)	0.06
Type of admission, n (%)			
Emergency	118 (20.3%)	3 (33.3%)	0.34
Diabetes mellitus, n (%)	92 (15.9%)	6 (66.7%)	<0.001[a]
Previous admission for gallstones, n (%)	58 (10.3%)	3 (33.3%)	0.02[a]
Previous upper abdominal surgery, n (%)	39 (6.7%)	1 (11.1%)	0.6
Previous lower abdominal surgery, n (%)	123 (21.2%)	0 (0%)	0.12
Days from admission to surgery	1.3 ± 1.9	5.1 ± 5.3	0.04[a]
Days from surgery to discharge	1.2 ± 2.6	12.1 ± 11.0	<0.001[a]
Total hospital stay, days	3.1 ± 6.0	17.2 ± 12.0	<0.001[a]
Operation time, min	87.4 ± 41.0	198.7 ± 69.4	<0.001[a]
Maximum body temperature, °C	36.9 ± 0.3	37.0 ± 0.3	0.27
WBC	8.0 ± 3.1	9.21 ± 5.1	0.2
Direct bilirubin	8.8 ± 25.9	47.8 ± 64.7	<0.001[a]
Total bilirubin	15.7 ± 32.9	57.5 ± 69.3	<0.001[a]
Alkaline phosphatase	128.5 ± 94.9	470.3 ± 399.5	<0.001[a]
Ultrasound findings, n (%)			
Pericholecystic fluid	27 (4.7%)	1 (11.1%)	0.37
Sonographic Murphy's sign	6 (1.03%)	0 (0%)	0.76
CBD diameter, mm	4.5 ± 2.6	4.1 ± 2.6	0.72

Obese is defined as BMI > 30. CBD, common bile duct; CTO, conversion to open group; LC, laparoscopic cholecystectomy group; WBC, white blood cells.

[a]Significance indicated by $P < 0.05$.

Saudi Arabia.[5,9,10,12,15–19] An analysis of different preoperative factors showed that patients who required conversion to open surgery were more likely to exhibit the following characteristics: male sex, older than 40 years of age, history of diabetes, history of hospitalization for gallstones, and increased total bilirubin, direct bilirubin, or alkaline phosphatase levels. Unlike previous studies,[3,9,17] we did not observe an association between BMI greater than 30 and conversion to open cholecystectomy. When studying the intraoperative factors, we found that adhesions, bleeding, and stone spillage were associated with conversion. These findings are consistent with those of previous reports in the literature.[3,9,10,12,15–18]

Table 3 Comparison of intraoperative factors of the laparoscopic group and conversion group

Variable	LC (n = 574)	CTO (n = 9)	*P*
Unclear anatomy	18 (3.1%)	1 (11.1%)	0.18
Adhesions	124 (21.4%)	8 (88.9%)	<0.001[a]
Thick gallbladder wall	38 (6.6%)	0 (0%)	0.43
Bleeding	24 (4.1%)	2 (22.2%)	0.01[a]
Stone spillage	30 (5.2%)	2 (22.2%)	0.03[a]
Bile spillage	67 (11.6%)	2 (22.2%)	0.32

Values are n (%). CTO, conversion to open group; LC, laparoscopic cholecystectomy group.

[a]Significance indicated by $P < 0.05$.

The lower rate of conversion reported we observed could be explained by the fact that our study was limited to a single-center university hospital setting where the surgeons have extensive experience with laparoscopy. This could have greatly reduced the rate of conversion, even when risk factors for conversion were present.[20]

Laparoscopic cholecystectomy performed emergently is considered a risk factor for conversion in Saudi Arabia. This greatly influences the management of acute biliary diseases like acute cholecystitis, biliary pancreatitis, and biliary obstructive jaundice.[12] Approximately 20% of our patient population underwent emergent laparoscopic cholecystectomy. Our findings showed that the risk of conversion in an emergency setting was not higher than that in an elective setting. Therefore, surgeons in Saudi Arabia may be more inclined to offer laparoscopic rather than interval cholecystectomy to patients with acute biliary complications.

Our study was limited by its retrospective design and conduct at a tertiary care university hospital. Although this might limit generalizability, the fact that laparoscopic cholecystectomy is commonly performed at most of the hospitals in Saudi Arabia makes our results more important for use as a local estimate of the risk of conversion to open surgery.

Conclusion

We identified the risk factors for conversion to open cholecystectomy in a local setting in Saudi Arabia. Recognizing these risk factors would greatly help surgeons to plan better to manage possible complications and to be well prepared for surgery, regardless of the need for conversion; this would also help them to predict the chances of conversion. Patients at higher risk for conversion should be well informed about laparoscopic surgery and the possibility of conversion. These patients might have a higher chance of undergoing complete laparoscopy if more experienced surgeons perform the procedure.

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