

Advanced laparoscopic training and outcomes in laparoscopic cholecystectomy

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Background: Advanced laparoscopic training is becoming a valuable asset for surgeons as more procedures are carried out in a minimally invasive fashion. The purpose of our study was to determine whether laparoscopic fellowship training affects outcomes in patients undergoing laparoscopic cholecystectomy for acute cholecystitis.

Methods: We obtained data from a retrospective review of 110 patients with acute cholecystitis who underwent laparoscopic cholecystectomy on an urgent basis from March 2002 to June 2005. We compared the outcomes of 31 patients whose surgeries were performed by a surgeon with advanced laparoscopic training with those of 79 patients whose surgeries were performed by surgeons without such training.

Results: The 2 groups were similar in terms of demographics and time to surgery. Outcome measures included conversion rates, postoperative length of stay (LOS) and complications. There was a significant difference in conversion rates (3.2 % v. 16.5 %, $p = 0.050$) and postoperative LOS (1.77 v. 2.82 d, $p < 0.006$) between the 2 groups, but there was no difference in the rate of postoperative complications. There was no significant difference in conversion rates among the surgeons without advanced training ($p = 0.64$).

Conclusion: Based on our results, laparoscopic cholecystectomy in acute cholecystitis is associated with improved outcomes when performed by a surgeon with fellowship training in laparoscopic surgery.

Contexte : La formation avancée en laparoscopie devient un atout très utile pour les chirurgiens à mesure que les interventions minimalement effractives gagnent en popularité. Notre étude avait pour but de déterminer si la formation en laparoscopie au niveau de la surspécialisation affectait les résultats de la cholécystectomie laparoscopique chez des patients souffrant de cholécystite aiguë.

Méthodes : Nous avons recueilli les données d'une analyse rétrospective de 110 patients souffrant de cholécystite aiguë soumis à une cholécystectomie laparoscopique urgente entre mars 2002 et juin 2005. Nous avons comparé l'issue du traitement chez 31 patients opérés par un chirurgien formé en laparoscopie avancée aux résultats obtenus chez 79 patients opérés par des chirurgiens n'ayant pas suivi ce type de formation.

Résultats : Les 2 groupes étaient similaires pour ce qui est des caractéristiques démographiques et du délai avant chirurgie. Les paramètres observés incluaient les taux de conversion, la durée du séjour post-opératoire et les complications. On a noté une différence significative quant aux taux de conversion (3,2 % c. 16,5 %, $p = 0,050$) et à la durée du séjour postopératoire (1,77 c. 2,82 j, $p < 0,006$) entre les 2 groupes, mais aucune différence quant aux taux de complications postopératoires. On n'a noté aucune différence significative quant aux taux de conversion parmi les chirurgiens n'ayant pas suivi de formation avancée ($p = 0,64$).

Conclusion : Selon nos résultats, la cholécystectomie laparoscopique pour cholécystite aiguë donne de meilleurs résultats lorsqu'elle est effectuée par des chirurgiens qui ont reçu une formation avancée en chirurgie laparoscopique.

Laparoscopic procedures have become increasingly common since the introduction of laparoscopic cholecystectomy in the late 1980s. Benefits of laparoscopic procedures, such as decreased postoperative pain and faster recovery, have been demonstrated in numerous studies in the past.¹⁻⁶ As a consequence, the variety and technical complexity of procedures performed through a minimally invasive approach have grown considerably. Inevitably,

this has lead to increased demand for more advanced training in laparoscopic surgery among residents entering the workforce.

The benefits of minimally invasive surgery (MIS) fellowship training on outcomes have been documented in a number of procedures, including gastric bypass, laparoscopic colorectal surgery and Nissen fundoplication.⁷⁻¹² Although the use of minimally invasive surgery has become routine in acute cholecystitis, the effects of advanced training on outcomes in this clinical setting have not been well studied.

The purpose of our study was to determine whether MIS fellowship training has an effect on outcomes in patients with acute cholecystitis undergoing cholecystectomy, a standard laparoscopic procedure.

METHODS

We collected data from the medical records of patients who had laparoscopic cholecystectomy on an urgent basis after presenting to the emergency department at the Health Sciences Centre in St. John's, NL, between March 2002 and June 2005. We compared the outcomes of consecutive patients whose surgeries were performed by a surgeon with MIS fellowship training with those of consecutive patients whose surgeries were performed by 4 surgeons without formal advanced laparoscopic training.

The attending surgeons diagnosed acute cholecystitis based on a combination of clinical findings, laboratory data and imaging results. We excluded patients who were found to have a concurrent preoperative diagnosis of gallstone pancreatitis or choledocholithiasis from our study. We recorded the age, sex and time to surgery (defined as time from onset of symptoms to time of surgery) for all patients. The main outcome measures included rate of conversion to open cholecystectomy, postoperative length of stay (LOS) and complication rates. To provide a more objective assessment of the severity of the patients' conditions, we compared the imaging, laboratory and final pathology results of the patients treated by MIS-trained and non-MIS trained surgeons. In addition, we compared the conversion rates

among the non-MIS trained surgeons. Finally, we performed separate analyses comparing the complication rates and LOS among patients whose surgeries were converted versus those whose surgeries were unconverted, as well as the LOS of patients whose surgeries were unconverted among the MIS-trained and non-MIS trained surgeons.

We performed our statistical analysis using the Student *t* test, χ^2 test and Fisher exact test, where applicable. We considered results to be significant at $p \leq 0.05$.

RESULTS

We included data for 110 patients in our study. Of these, 31 patients' surgeries were performed by a surgeon with MIS fellowship training compared with 79 patients whose surgeries were performed by 4 surgeons without formal advanced laparoscopic training. The surgical practice experience of the non-MIS trained surgeons ranged from 7 to 39 years. Two of them did not have fellowship training, whereas 2 had fellowship training in non-MIS areas. The MIS-trained surgeon had been in practice for 5 years.

Patient age, sex and time to surgery were similar among the patients of the surgeon with MIS fellowship and those of the non-MIS trained surgeons (Table 1). There was a significant difference in conversion rates and postoperative LOS upon comparing the MIS-trained surgeon's patients to those of the non-MIS trained surgeons (Table 2). The reason for conversion among patients of the MIS-trained surgeon was severely inflamed gallbladder; the reasons for conversion among patients of the non-MIS trained surgeons were severely inflamed gallbladder ($n = 8$), abnormal anatomy ($n = 1$), uncontrolled bleeding ($n = 2$) and poor visibility secondary to adhesions ($n = 2$).

There was a significant difference in postoperative LOS between the patients of the MIS-trained surgeon and those of the non-MIS trained surgeons (Table 2). There was 1 outlying patient of a non-MIS trained surgeon who had a 17-day stay in hospital: a patient with necrotizing cholecystitis who had undergone a difficult laparoscopic

Table 1. Characteristics of patients who underwent laparoscopic cholecystectomy at the Health Sciences Centre in St. John's, NL, between March 2002 and June 2005

Variable	Surgeon group; mean (range)*		<i>p</i> value
	MIS-trained	Non-MIS trained	
Age, yr	49.0 (19-82)	45.5 (21-89)	0.37†
Sex, male:female	9:22	21:58	0.80‡
Time to surgery, d	3.7 (0.4-10.0)	3.8 (0.2-15.0)	0.91†

MIS = minimally invasive surgery.
 *Unless otherwise indicated.
 †Student *t* test.
 ‡ χ^2 test.

Table 2. Outcomes of patients who underwent laparoscopic cholecystectomy at the Health Sciences Centre in St. John's, NL, between March 2002 and June 2005

Outcome	Surgeon group		<i>p</i> value
	MIS-trained	Non-MIS trained	
Conversion, no. (%)	1 (3.2)	13 (16.5)	0.050*
Postoperative LOS, mean (range) d	1.77 (1-5)	2.82 (1-17)	0.006†
Postoperative complications, no. (%)	5 (16)	12 (15)	0.90‡

LOS = length of stay in hospital; MIS = minimally invasive surgery.
 *Fisher exact test.
 †Student *t* test.
 ‡ χ^2 test.

cholecystectomy. The patient was thought to have a postoperative cystic duct leak and was treated with drains and eventually with endoscopic retrograde cholangiopancreatography. There were no other outliers in the study.

The average LOS among patients whose surgeries were converted was significantly higher than the average LOS among patients whose surgeries were unconverted (6.36 v. 1.97 d, $p < 0.001$). On comparing LOS of patients whose surgeries were unconverted among the MIS-trained and non-MIS trained surgeons, there was no statistically significant difference (1.67 v. 2.11, $p = 0.18$)

There was no difference in postoperative complication rates. The complications among patients treated by non-MIS trained surgeons included dehiscence ($n = 1$), cystic duct leak ($n = 4$), hypoxia ($n = 1$), ileus ($n = 1$), incisional bleed ($n = 1$), fever ($n = 2$), chest pain ($n = 1$) and retained common bile duct stone ($n = 1$). Complications among patients treated by the MIS-trained surgeon included fever ($n = 2$), cystic duct leak ($n = 2$) and retained common bile duct stone ($n = 1$). We excluded complications unrelated to the surgery from our analysis.

There were significantly more complications associated with patients whose surgeries were converted compared with those whose surgeries were unconverted (8/14 [57.1%] v. 10/86 [11.6%], $p < 0.001$). There were no complications associated with the 1 patient of the MIS-trained surgeon whose surgery was converted. The complications among patients of the non-MIS trained surgeons whose surgeries were converted included dehiscence ($n = 1$), cystic duct leak ($n = 2$), hypoxia ($n = 1$), incisional bleed ($n = 1$), fever ($n = 1$) and chest pain ($n = 1$).

We compared the presenting laboratory values (aspartate aminotransferase [AST], alanine aminotransferase [ALT], alkaline phosphatase [ALP], bilirubin, white blood-cell count [WBC]) among patients of the MIS-trained surgeon and those of the non-MIS trained surgeons. We also compared the ultrasound results (based on radiologic acute cholecystitis criteria of gallstones plus 2 of gallbladder wall > 4 mm, pericholecystic fluid or sonographic Murphy sign) and final pathology (acute v. chronic cholecystitis/cholelithiasis) between the 2 groups of patients. We found no significant difference between the 2 groups in AST (1.17 v. 1.47 $\mu\text{kat/L}$, $p = 0.58$), ALT (1.13 v. 1.43 $\mu\text{kat/L}$, $p = 1.01$), ALP (1.57 v. 1.59 $\mu\text{kat/L}$, $p = 0.87$) or bilirubin values (16.0 v. 17.8 $\mu\text{mol/L}$, $p = 0.75$). Likewise, there was no significant difference in average WBC (12.3 v. $11.7 \times 10^9/\text{L}$, $p = 0.38$) or in the total number of patients with elevated WBC ($> 10.8 \times 10^9/\text{L}$; 20/21 v. 39/79, $p = 0.15$). There was no significant difference in the number of patients with ultrasound findings of acute cholecystitis (10/26 v. 33/68, $p = 0.38$). No ultrasound data were available for 5 patients of the MIS-trained surgeon and 11 patients of the non-MIS trained surgeons. Finally, there was no significant difference in the number of patients with a pathological diagnosis of acute cholecystitis (15/31 v. 32/79, $p = 0.45$).

A separate analysis comparing the conversion rates among the different non-MIS trained surgeons revealed no significant difference ($p = 0.64$).

DISCUSSION

Advanced MIS training is intended to provide a surgeon with a skill set different from that gained through practice of basic laparoscopic procedures alone.¹³ Greater versatility in maneuvering instruments from a multitude of different perspectives, as well as a different approach to tissue dissection in the 2-dimensional realm are acquired. It would follow that this enhanced set of skills would translate into improved performance of more basic procedures such as laparoscopic cholecystectomy.

Given the frequency with which laparoscopic cholecystectomy is performed in most centres today, appreciable differences in patient outcomes among MIS-trained and non-MIS trained surgeons could have considerable implications if cost-effectiveness analyses were to be performed.

Our 1-centre study demonstrates a positive association between advanced MIS training and laparoscopic cholecystectomy outcomes in the form of conversion rates and postoperative LOS in an acute setting. The conversion rates and LOS among patients of the non-MIS trained surgeons correlate with data previously published.^{2,5,14,15}

Our study did not control for additional surgeon factors such as skill set and approach, which are difficult to quantify; these factors would have been better controlled if the study included multiple MIS-trained surgeons across multiple institutions. With respect to nonsurgical factors, patients in both groups were comparable in terms of severity of presentation and time to surgery. To retrospectively provide a more objective assessment of the severity of patients' conditions, we compared the imaging, laboratory and final pathology results among the patients of the MIS-trained and the non-MIS trained surgeons. We found no significant difference between the groups. In addition, we identified no significant difference in time to surgery between the groups.

The decreased postoperative LOS that we observed among patients of the MIS-trained surgeon may be attributable to a number of factors. Patients in this group had a significantly lower conversion rate, which has been associated with a decreased LOS.¹⁻⁶ The MIS-trained surgeon's greater experience with postoperative care of laparoscopy patients could also have led to greater comfort with early discharge. However, the discharge criteria used by surgeons at our centre (i.e., stable vital signs, tolerance of oral intake, absence of any postoperative complications) are fairly universal. Furthermore, on comparing the LOS of patients whose surgeries were unconverted among MIS-trained and non-MIS trained surgeons, we found no statistically significant difference between the groups. Additional factors not

included in our study such as shorter duration of surgery could also have affected LOS.

The complication rates that we observed in both groups were similar, though the nature of the complications was different. The complications among patients treated by the MIS-trained surgeon were more localized, whereas those of patients treated by the non-MIS trained surgeons included more systemic complications or complications related to the incision. This difference may be a reflection of the greater number of converted procedures among patients of the non-MIS trained surgeons.

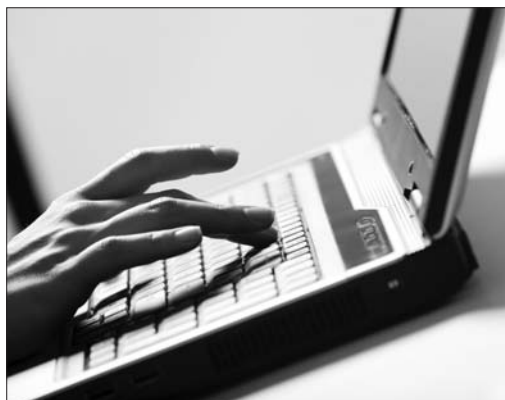
Overall, our study was a retrospective review with a relatively small pool of surgeons at a local centre; therefore, the results of only 1 surgeon with MIS training could be used in our analysis. Ideally, multiple MIS-trained surgeons from multiple institutions would be included in such a study to yield greater power. Given the significant difference in conversion rates and postoperative LOS that we observed between the 2 groups in our study, it is conceivable that similar results could be found if the study population was broadened.

Competing interests: None declared.

Contributors: Dr. Pace designed the study and Dr. Bohacek acquired the data, which both authors analyzed. Dr. Bohacek wrote the article, which Dr. Pace reviewed. Both authors approved final publication.

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