

The Effect of Afternoon Operative Sessions of Laparoscopic Cholecystectomy Performed by Senior Surgeons on the General Surgery Residency Program: A Comparative Study

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OBJECTIVE: Laparoscopic cholecystectomy (LC) has been the gold standard for surgical treatment of gallbladder disease since 1980. This laparoscopic surgical procedure is one of the first to be performed by general surgery residents. There is a learning curve required to excel at performing LC. During this period, the operation needs to be performed under the supervision of a senior surgeon. The purpose of this study was to compare LC performed by residents with that performed by senior surgeons using the following parameters: operative time, conversion rate, complication rate, and mean length of hospital stay.

METHODS: This retrospective study included 1219 patients who underwent elective LC in our institute—788 operated on by a senior surgeon and 431 by a resident.

RESULTS: The mean operative time was 39 ± 19 minutes. There was a significant difference between the groups, as the mean operative time for the resident group was 49.9 ± 13 compared with 33.7 ± 6 for the senior surgeon group. The overall conversion rate was 2.1%, the complication rate was 2.2%, and the mean length of hospital stay was 1.5 days. There were no statistically significant differences between the groups for these parameters.

CONCLUSIONS: The only significant difference between the groups was a longer operative time, as the conversion rate, complication rate, and mean length of stay were the same. Therefore, it is safe for LC to be performed by residents supervised by a senior surgeon. (J Surg Ed 72:1014-1017. © 2015 Published by Elsevier Inc. on behalf of the Association of Program Directors in Surgery)

KEY WORDS: laparoscopic cholecystectomy, teaching setup, operative residency program, duration of surgical procedures

COMPETENCIES: Practice-Based Learning and Improvement, Patient Care, Medical Knowledge

INTRODUCTION

The reported incidence of gallbladder disease in the United States ranges from 5% to 24% of the adult population.¹ Overall, 1% to 4% of the patients will become symptomatic each year. Since the introduction of laparoscopic cholecystectomy (LC) in the late 1980s, this technique has become the gold standard approach with more than 1 million procedures performed yearly in the United States.²⁻⁴ The American College of Surgeons National Surgical Quality Improvement Program database included 65,511 patients who underwent cholecystectomy, appendectomy, or inguinal hernia repair and demonstrated that approximately 90% of all cholecystectomies performed in North America are done laparoscopically, the remainder still being performed by the open approach.^{2,5,6}

Of all laparoscopic procedures, LC is one of the first operations performed by residents training in laparoscopic surgery.⁷ Logically, the operative time is prolonged when surgery is performed by trainees owing to the learning curve. But does it jeopardize the patient in any other ways? Is it ethical to perform LC in a teaching setup?

The aim of our current work was to compare the results of laparoscopic cholecystectomies performed by residents supervised by senior surgeons to the ones performed by senior surgeons investigating the differences in operative time, conversion rate, complication rate, and mean length of hospital stay.

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MATERIAL AND METHODS

This is a retrospective study performed with the authorization of the Institutional Review Board of our medical center (No. 151/13). All patients who underwent elective LC during the period July 2007 to December 2012 entered the study. The indications for surgery were biliary colic, complicated cholelithiasis and cholecystocholedocholithiasis (resolved obstructive jaundice, resolved biliary pancreatitis, and resolved ascending cholangitis). Patients who underwent interval LC (following a resolved episode of acute cholecystitis), LC during an episode of acute cholecystitis, or LC after percutaneous cholecystostomy; patients who underwent LC during another operation such as laparoscopic adjustable gastric banding or any type of colectomy; and patients with gastroesophageal reflux disease were excluded from the study.

Patient data were collected in a computerized database. The following parameters were studied: age, sex, comorbidities, length of surgery, need for perioperative blood transfusion, conversion rate, complication rate, length of hospital stay, and mortality. The operating surgeons were classified as senior surgeons or residents. *Residents were from the second year of their residency but were not categorized further according to their level of residency.*

All operations were performed using the same technique: four trocars (2 × 10 mm and 2 × 5 mm), insufflating the abdominal cavity to a maximum pressure of 15 mm Hg. Prophylactic antibiotics were used in all operated patients, usually one portion of a third-generation cephalosporin.

Patients were divided into 2 groups—operations performed by senior surgeons as the primary surgeon and those that were performed by residents with the supervision of a single or 2 scrubbed senior surgeons. Patients operated on by senior surgeons underwent surgery during afternoon sessions based on “fee for service.” The health care system in Israel covers the payment for almost all of the surgical procedures performed in the morning. Afternoon procedures are covered by specific contracts made between the hospital and the insurance companies aiming to reduce the

waiting time for specific types of procedures. The patients have no way of choosing the surgeon. In our study, the attending surgeons who operated in the afternoon were given specific days without being able to select their patients. The same group of attending surgeons was randomly selected to supervise the procedures performed in the morning by the residents.

STATISTICAL ANALYSIS

To compare quantitative (continuous) variables between 2 independent groups, the 2-sample *t* test was applied as well as the nonparametric Mann-Whitney test. The association between 2 categorical variables was assessed using either the chi-square test or Fisher exact test. All statistical tests applied were 2 tailed, and a $p \leq 5\%$ was considered statistically significant. Statistical analysis was performed using the software program Statistical Package for the Social Sciences (SPSS).

RESULTS

Between July 2007 and December 2012, 1219 patients who met the previously mentioned eligibility criteria underwent elective LC at our medical center. The senior group consisted of 788 patients (64.6%) operated on by a senior surgeon assisted by juniors and the junior group consisting of 431 patients (35.4%) operated on by residents at various levels of their residency program assisted by a senior surgeon or surgeons.

The demographic data, including comorbidities as well as operative time, conversion rate, length of hospital stay, and complications are listed in the [Table](#).

For the whole cohort of patients, the female to male ratio was 3:1, and the mean age was 50.0 ± 17 years. In the senior group, the mean age was 46.9 ± 16 years compared with 55.7 ± 17 years in the junior group. There were lesser comorbidities in the senior group of patients. All of these differences were statistically significant.

TABLE. Demographics and Operative Data

	Senior Surgeon	Junior Surgeon	p Value
Demographics			
Number	788 (64.6%)	431 (35.4%)	
Age	46.9 ± 16	55.7 ± 17	0.001
Female/male	3.5/1	2.5/1	0.018
Hypertension	26.1%	37.9%	0.001
Ischemic heart disease	5.8%	11.0%	0.011
Diabetes mellitus	10.1%	18.1%	0.001
Operative data			
Operative time (min)	33.7 ± 6	49.9 ± 13	0.001
Conversion	1.8%	2.8%	0.3
Complication	2.0%	2.5%	0.55
Length of stay	1.41	1.67	0.1

The mean operative time was 39 ± 19 minutes. There was a statistically significant difference between the groups, as in the senior group, the operative time was 33.7 ± 6 minutes, and in the junior group, it was 49.9 ± 13 minutes. The mean length of hospital stay was 1.5 days (1.41 days in the senior group vs 1.67 in the junior group, $p = 0.1$). There was a 2.1% (25 patients) conversion rate (14 patients in the senior group [1.8%] and 12 patients in the junior group [2.8%; $p = 0.3$]). Complications occurred in 27 patients (2.2%; 16 patients in the senior group and 11 patients in the junior group, $p = 0.5$). There were no cases of common bile injury. There were 5 cases of cystic duct leakage (3 in the senior group and 2 in the residents group, all managed conservatively). There were no statistically significant differences between the groups for these parameters. All the data are summarized in the [Table](#).

DISCUSSION

More than 80% of the surgical procedures performed in North America are performed at teaching hospitals by residents training to become “the future” surgeons.⁸ A vast amount of literature has been published discussing the “teaching effect” on operative time and complications. Training a resident to a level of excellence in performing LC without supervision requires a learning curve. The learning curve is defined as the number of times the procedure must be performed with a senior surgeon supervising the operation before the resident can perform it safely by himself or herself.^{9,10}

Fisher and Hong showed that the outcome after pancreaticoduodenectomy performed by a general surgical resident under the supervision of senior surgeons is comparable to national best practice outcomes.¹⁰

Many previous studies proved that resident participation results in a longer operative time, which is translated to a greater financial cost. Bridges et al.¹¹ from the University of Tennessee Medical Center extrapolated from their results that the annual cost of training residents in the operating room is approximately 53 million dollars.

Most hospitals estimate cost based on the amount of time that the patient is in the operating room. The operating room time consists of in-the-room operating time (30%) and time actually spent performing the operation (70%).¹²

The excess in operative time when residents operates relates to the 70% spent on the operation.^{10,13-16}

Zdichavsky et al.⁷ reported that when the LC operative time is prolonged for more than 2 hours, the risk of postoperative complications is 4 times higher than an intervention that lasts less than 60 minutes.

Chen et al.¹⁷ reported that LC performed in pediatric patients by a less experienced surgeon is a strong predictor of higher length of hospital stay and cost. Jackson et al.¹⁸

evaluated the effect of operative time on outcome in laparoscopic surgeries including cholecystectomy. They analyzed 76,748 patients and showed that increasing operative time was independently associated with increased odds of complications.¹⁸ On the contrary, Kiran et al.¹⁹ reviewed the results of the National Surgical Quality Improvement Program database (2005-2007) and concluded that resident involvement in surgical procedures is safe. They showed that the rate of severe complications and mortality were not statistically different. It is not clear whether shorter operative time represents advanced skills and a smooth intraoperative course or potentially less attention to detail, which may place the patients at risk for complications.

In this current work, we tried to evaluate the results of LCs performed by residents compared with those performed by seniors.

Although we do not have any explanation for the different demographics and past medical history, the patients operated on by seniors were significantly younger with fewer comorbidities and consisted of more female patients compared with the group operated on by residents ($p < 0.05$).

The operative time was significantly different between the groups ($p < 0.05$), with operations performed by junior surgeon being longer ($[49.9 \pm 13 \text{ min}]$ compared with the senior group $[33.7 \pm 6 \text{ min}]$). These 16 minutes per procedure are translated to an excess of more than 120 operating-hour expenses for the hospital (approximately 400,000 NIS). However, one should not forget that the fee paid for these afternoon sessions is much higher.

An interesting finding was that in the junior group, when the junior surgeon was assisted by 2 seniors, the operative time was significantly longer compared with when he or she was assisted by a single senior and another resident (48.3 min vs 53.3 min, $p < 0.05$).

The conversion rate, length of hospital stay, and complication rate were not significantly different between the groups.

A major by-product emerged from this retrospective study. The wish to shorten the waiting list on the one hand and allowing senior surgeons to earn extra money on the other hand has brought the hospital management to a strategic decision to allow afternoon sessions for senior surgeons based on fee per service. This approach has totally changed the proportion of LCs performed by seniors (64.6%) compared with residents (35.4%). These figures contradict the basic aim of an academic hospital—to teach residents. Based on the “converted” results, we are going to change the strategy and LC will be performed by residents at the end of their residency during the afternoon sessions with the aim that 75% to 80% of all LCs will be performed in the future by residents.

CONCLUSION

Our results confirm that when supervised by an experienced surgeon, less experienced surgeons can perform LC as safely as experienced surgeons, but the operating time is longer than expected.

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