SCIENTIFIC PAPER

Laparoscopic Cholecystectomy Performed by Surgical Trainees

S. G. Koulas, MD, J. Tsimoyiannis, MD, I. Koutsourelakis, MD, N. Zikos, MD, G. Pappas-Gogos, MD, P. Siakas, MD, E. C. Tsimoyiannis, MD

ABSTRACT

Objective: The aim of this study was to assess morbidity, mortality, and outcome in select patients after laparoscopic cholecystectomy performed by consultants or by Specialist Registrars (SpRs) and Senior House Officers (SHO), in the General Hospital of Ioannina 'G. Hatzikosta' in northwestern Greece.

Methods: Between January 1, 2001 and December 31, 2005, 1370 laparoscopic cholecystectomies were performed, 445 (33%) by SpRs and SHO and 925 (67%) by consultants. Patients included 982 (71.3%) women and 388 (28.7%) men. The mean age was 46.2 years (range, 17 to 79). All patients had routine blood tests (including liver function tests), electrocardiography, chest x-ray, and abdominal ultrasound scan performed preoperatively. All patients received a general anesthesia, and the standard Reddick and Olsen technique was performed. The Harmonic scalpel was used in all cases.

Results: Four conversions (0.3%) were required to an open procedure, (2 in the SpRs and SHO group and 2 in the group of consultants), because of impossible recognition of anatomy around Calot's triangle. The mean operative time was 57 minutes (range, 33 to 97) for SpRs and SHO, while for the consultants it was 49 minutes (range, 27 to 78, P=0.25). Mortality rate was 0% in both groups. There were 44 major complications (2.7%), 17 in the SHO and SpRs group (3.7%) and 27 in the consultant group (1.7%, P=0.11). The complications included bowel thermal injury (consultants [cons], 1; residents [res], none); bile duct injury (cons, 1; res, none); bile leak (cons, 3; res, 5); hemorrhage (cons, 2; res, 2); hematomas at the trocar sites (cons, 5; res, 4); inflammation of the port site at the umbilicus (cons, 4; res, 5); paralytic ileus (cons, 4; res, 3); and hemorrhage from the subxiphoid trocar (cons, 2; res, 3), which stopped spontaneously.

The mean hospital stay was 1.3 days, while all the patients resumed their normal activities after 11.7 days (range, 7 to 19).

Conclusion: Supervised laparoscopic cholecystectomy performed by trainees does not increase surgical morbidity and does not compromise surgical outcome.

Key Words: Laparoscopy, Cholelithiasis, Cholecystectomy, Surgical training, Complications, Outcome.

INTRODUCTION

The discipline of surgery has become even more complex with the rapid introduction of revolutionary technologies. Laparoscopic surgery is the simplest and first of those new directions. The establishment of laparoscopic cholecystectomy as a standard method and the associated learning curves has been described by several authors.[1–3] However, complications still remain, including the need to convert the operation to an open procedure.

The introduction of new technologies into our hospitals and into our operative table must be evaluated on multiple levels. Laparoscopy and robotic surgery have created a need for new and different skills and abilities that must be familiar to both practicing surgeons and trainees.[2] Training of future surgeons is a mission of vital importance to society. Cholecystectomy has always been an essential part in the training program of surgical residents in Greece.[4] Since the introduction of the laparoscopic technique in the early 1990s, laparoscopic cholecystectomy (LC) has become the preferred procedure and now is used in 75% to 80% of cases.[5] Some authors[2,6] have emphasized the importance of LC as a crucial laparoscopic teaching procedure, and an increasing number of LCs are being performed by junior residents under direct supervision.

The aim of this retrospective study was to compare the outcome, efficacy, and morbidity rates between consultants and higher-level surgical trainees [Specialist Registrars (SpRs) and Senior House Officers (SHO)] in patients who underwent LC.

Department of Surgery, General Hospital of Ioannina 'G. Hatzikosta', Ioannina, Greece (all authors).

Address reprint requests to: Spyridon Koulas, MD, Magoulades 49081, Corfu, Greece. Telephone: +30 2663051236, +30 6947602950, E-mail: skoulas@freemail.gr

METHODS

Between January 1, 2001 and December 31, 2005, 1370 patients underwent laparoscopic cholecystectomy in the General Teaching Hospital Ioannina "G. Hatzikosta" in northwestern Greece. Of these, 445 patients were operated on by 3 trainees and the other 925 patients by 3 consultants.

In Greece, surgical residents begin to operate under close supervision in the third or fourth year of their residency.[4] LC was done with the patient under general anesthesia. Patients with acute cholecystitis, (mean empyema of the gallbladder), choledocholithiasis, or a history of jaundice were excluded from this study.

Surgical Technique

After a subumbilical incision, pneumoperitoneum was established using the Hasson technique. Four trocars were then inserted: two 10-mm ports in the periumbilical and subxifoid regions and two 5-mm trocars in the right upper abdomen. A dissection hook was used for preparation of Calot's triangle and for dissecting the gallbladder from the liver. The cystic duct and cystic artery were divided after having been clipped by single-use endoscopic applicators. The complete operation was done by 1 operator and 2 assistants. In our study, the principal surgeon was considered the one who identified and dissected the structures in Calot's triangle.

Residents were introduced to laparoscopic techniques by didactic lectures and by using a black box operation stimulator. Subsequently, training surgeons participated in operations as laparoscopic camera operators, and then progressed stepwise to being first assistant and to operating surgeon after the acquisition of the appropriate skills.

All teaching operations were performed under the instruction and supervision of an experienced laparoscopic surgeon.

All patients were included in the American Society of Anesthesiologists (ASA) grade 1 or 2 and underwent preoperatively abdominal ultrasound scan, chest x-ray, electrocardiography, and routine blood tests including liver function tests. Patient demographics and operative details are summarized in **Table 1**.

The data concerning the indication for surgery and the histopathological diagnosis of the gallbladder are shown in **Table 2**.

Table 1.
Comparison of the Groups Who Underwent Laparoscopic Cholecystectomy by Residents and Surgeons

	Surgeons n = 925 (67%)	Residents n = 445 (33%)
Sex		
Male	290 (31%)	98 (22%)
Female	635 (69%)	347 (78%)
Mean age (years)	49.3	44.4
Previous abdominal operation	90 (10%)	49 (11%)
Mean body mass index (kg/m^2)	25.1	25.9
Jaundice	0	0
Hasson technique	925	445

Table 2.
Indication for Operation and Histological Diagnosis

	Surgeons n = 925	Residents n = 445
Indication for operation		
Symptomatic gallstones	901 (97.4%)	403 (90.5%)
Asymptomatic gallstones	24 (2.6%)	42 (9.5%)
Histopathological diagnosis		
Acute cholecystitis	57	7
Chronic cholecystitis	868	438

Statistical Analysis

All data collected were obtained by using the Statistical Package for the Social Sciences (SPSS, Chicago, Illinois, USA). An unpaired *t* test was used to compare the mean duration of the operation, the mean hospital stay, and the number of days needed for resumption of activity. An x^2 test was used to compare the complications, conversions, and mortality rates. A probability of <0.05 was accepted as significant. Results were reviewed by an independent researcher.

RESULTS

The data comparing patients who underwent laparoscopic cholecystectomy by surgeons and residents is in **Table 3**. The mean duration of the operation was 49 minutes for the surgeons and 57 minutes for residents ($P=0.12$). Neither conversion rate to laparotomy ($P=0.17$) nor complication rate ($P=0.06$) were significantly differ-

Table 3.
Comparison of Laparoscopic Cholecystectomies Performed by Surgeons and Residents

	Surgeons n = 925	Residents n = 445	P Value
Mean Duration of Operation (min)	49 (27–78)	57 (33–97)	0.12
Major Complications	27	17	0.06
Intraoperative			
Bowel thermal injury	1	0	
Bile duct injury	1	0	
Bile leak	3	5	
Hemorrhage	2	2	
Hematomas at trocar site	5	4	
Postoperative			
Inflammation at umbilicus port site	4	5	
Paralytic ileus	4	3	
Hemorrhage from subxiphoid trocar	2	3	
Jaundice	5	4	
Conversion to Laparotomy	2	2	0.17
Mortality Rate (%)	0	0	0.22
Mean Hospital Stay (d)	1.3	1.5	0.33
Return to Normal Activity	12.1	12.7	0.27

ent between surgeons and residents. Finally, the mean hospital stay was 1.3 and 1.5, respectively (P=0.33).

DISCUSSION

Considerable concerns exist in Europe that shortened training times combined with the restrictions on hours of work will compromise the competence of new surgeons. It is also essential that surgical trainees obtain adequate operative experience without any detriment to the patient. This study has shown that the grade of the operating surgeon (consultant or SpRs) has no predictive value for mortality or morbidity in patients undergoing LC.

Two other studies[7,8] exist comparing outcomes of LCs performed by surgeons and residents. Schol[7] and Bockler[8] in their studies in the early 1990s tried to evaluate the integration of the new surgical procedure into the training program of residents within 2 years of its introduction. They both concluded that the operator's grade does not affect the conversion rate or the number of complications. Despite the fact that the above-mentioned studies were conducted within the initial phase of the technique, it is quite impressive that their results were similar. As a consequence, the exposure of residents to these techniques was obligatorily limited, and thus they performed 172 and 89 laparoscopic cholecystectomies, respectively. Similar studies comparing outcomes in patients after colorectal,[9,10] vascular,[11] and breast[12] surgery show that no difference exists in outcomes between patients operated on by consultants and junior surgeons. Friedman and Pace[11] in their study found no significant difference between residents who were trained on animal models and those who were trained first as the camera operator and progressing to first assistant, without any training on a simulator. On the other hand, several authors have complained that the laparoscopic generation of surgeons start their training in biliary surgery without any experience with the open technique; however, less experience in open biliary surgery, apparently, does not influence the safety of LC.[13] As a matter of fact, surgeons who started LC after their residency had a higher rate of biliary complications than did colleagues who learned LC during their residency.[2]

The results of all studies (ours and those cited herein) indicate that with proper training and supervision, higher-level surgical trainees can achieve a satisfactory level of competence.

The majority of the scientific community[14] believes that a minimum of 20 to 35 laparoscopic cholecystectomies are

necessary for a surgical trainee to be able to use laparoscopic techniques safely.

In Greece,[4] only a few surgical educational programs offer a complete training program in laparoscopic surgery because of inadequate technological equipment and the insufficiency of the appropriate training infrastructure in our hospitals.

After laparoscopic cholecystectomy, 5 patients operated on by a surgeon and 4 by a resident became jaundiced, and endoscopic retrograde cholangiopancreatography was performed. Six patients had a papillotomy because of common bile duct stones that were successfully removed. In 3 patients, a biliary stent was inserted because of a papillary carcinoma.

The 2 most serious complications we had occurred in patients operated on by experienced surgeons. In the first case, during the dissection of the structures of Calot's triangle by using the Harmonic scalpel, we provoked a thermal injury of the bile duct due to the short, thick cystic duct. On the second postoperative day, the patient was jaundiced, and consequently we proceeded to an open laparotomy. We then recognized the lesion in the bile duct and choledochojejunostomy was performed.

In the second case, we accidentally provoked a thermal lesion on the transverse colon. On the fourth postoperative day, fecal peritonitis occurred, and consequently Hartmann's operation was performed.

It is evident that the above serious complications were both the result of lateral thermal injury caused by the Harmonic scalpel. Although the Harmonic scalpel is thought to transmit a lower amount of energy to the tissues and can reach lower temperatures (50°C to 100°C) than other instruments can that use high-frequency current, it is wise to use it with maximum attention. A recent study[15] suggests that tissue necrosis is greater if the Harmonic scalpel application time is continuous rather than the same total duration with a brief mid-point interruption.

CONCLUSION

We conclude that when residents are allowed to undertake supervised laparoscopic cholecystectomy in accordance with their level of experience, surgical outcomes are not compromised. Knowledge and awareness of complications are necessary prerequisites for the prevention of these complications for both learning and experienced surgeons.

References:

1. Cagir B, Rangraj M, Maffuci L, Herz BL. The learning curve for Laparoscopic Cholecystectomy. *J Laparoendosc Surg*. 1994; 4:419–442.

2. Friedman RL, Pace BW. Resident education in laparoscopic cholecystectomy. *Surg Endosc*. 1995;10:26–22.

3. Hodgson WJB, Bryne DW, Savino JA, Liberis G. Laparoscopic cholecystectomy. *Surg Endosc*. 1994;8:1058–1060.

4. Polymeneas G. The education of surgical trainees in basic laparoscopic surgery. *Hellenic Laparoendoscopic Surgery*. 1999; 1(3):1999.

5. Singh KK, Aitken RJ. Outcome in patients with colorectal cancer managed by surgical trainees. *Br J Surg*. 1999;86(10): 1332–1336.

6. Miller RE, Kimmelstiel FM. Surgical Laparoscopic experience during the first year on a teaching service. *Surg Gynecol Obstet*. 1992;175:523–527.

7. Schol FPG, Go PMNY, Gouma DJ, Kootstra G. Laparoscopic cholecystectomy in a surgical training programme. *Eur J Surg*. 1996;162:193–197.

8. Bockler D, Geoghegan J, Klein M, et al. Implications of laparoscopic cholecystectomy for surgical residency training. *JSLS*. 1999;3(1):19–22.

9. Singh KK, Aitken RJ. Outcome in patients with colorectal cancer managed by surgical trainees. *Br J Surg*. 1999;86(10): 1332–1336.

10. Tytherleigh M, Wheeler J, Birks M, Farouk R. Surgical specialist registrars can safely perform resections for carcinoma of the rectum. *Ann R Coll Surg Engl*. 2002;84:389–392.

11. Naylor AR, Thompson MM, Varty K, et al. Provision of training in carotid surgery does not compromise patient safety. *Br J Surg*. 1998;85(7):939–942.

12. Moorthy K, Asopa V, Wiggins E, Callam M. Is the reexcision rate higher if breast conservation surgery is performed by surgical trainees? *Am J Surg*. 2004;188:45–48.

13. Zacara F, Catarazi M, Gossetti F, Carboni M. Senior versus proctored young residents surgeons experience in Laparoscopic Cholecystectomy. *J Laparoendosc Surg*. 1995;5:303–307.

14. Jakimowicz J. The European association for endoscopic surgery, recommendations for training in laparoscopic surgery. *Ann Chir Gynaecol*. 1994;83:137–143.

15. Perko Z, Pogorelic Z, Vilovic K, Bilan K, Mimica Z, Srsen D. Lateral thermal injury of rat abdominal tissue following harmonic scalpel application. Presented at: 14th International Congress of EAES; June 9–13, 2005; Venice.