Annals of the Royal College of Surgeons of England (1992) vol. 74, 237–241

Laparoscopic laser cholecystectomy: results of the technique in 210 patients

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Key words: Cholelithiasis; Cholecystectomy; Peritoneoscopy

The results of laparoscopic laser cholecystectomy (LLC) in a consecutive series of 210 patients, operated on between May 1990 and August 1991, were assessed to analyse the advantages of the technique and to detail the causes of any technical problems, failures, or complications. The operations were performed by JMcKW and ADNS.

A success rate of 98% (206/210) was achieved with a minor complication rate of 13% (26/210) and major complication rate of 3% (7/206), including three patients (3/206; 1.5%) who had a reactionary haemorrhage postoperatively, two requiring laparotomy. The length of hospital stay was 48 h or less in over 80% (148/184) of the patients. The period of absence from work was 2 weeks or less in over 90% (118/130) of the patients.

Cholecystectomy can safely be performed laparoscopically and this procedure has significant advantages over open cholecystectomy.

The operation of cholecystectomy was first performed by Langenbuch in Berlin in 1882 (*1*) and since that time it has become the standard treatment for gallbladder stone disease. The morbidity and mortality associated with cholecystectomy have decreased over the last 25 years, and mortality rates of less than 0.1% have been reported, with a procedure-related morbidity rate of 2.2% (*2*). However, open cholecystectomy is a major procedure involving an extensive abdominal incision, a hospital stay of up to 1 week and a prolonged period of convalescence. For this reason other methods of treating gallbladder stones have been developed including lithotripsy (*3*), contact dissolution (*4*), oral dissolution (*5*) and percutaneous stone removal (*6–8*). These alternatives to cholecystectomy leave the gallbladder in place and there is therefore a risk of recurrent stone formation (*9*). Laparoscopic cholecystectomy does not have this drawback, since the diseased gallbladder is removed. We report the results of this procedure in a series of 210 patients.

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Patients and methods

Patients

At the beginning of the series, eight patients with symptomatic gallstones who had no history of jaundice or pancreatitis were selected as suitable candidates for LLC. Of these eight, seven underwent successful LLC; the procedure was abandoned for technical reasons (see below) in the last patient who therefore had an open operation. Since that time there has been no selection of patients for LLC, the procedure being offered to all patients requiring surgery for gallbladder stones. However, one patient opted for open cholecystectomy rather than LLC out of choice and another patient who also required hysterectomy and bilateral oophorectomy for ovarian carcinoma underwent an open operation. Patients with a history of jaundice or pancreatitis, or abnormal liver function tests were referred for endoscopic retrograde cholangiopancreatography (ERCP) preoperatively and, if this revealed stones in the common bile duct, endoscopic sphincterotomy was performed.

A series of 210 patients (53 (25%) male; 157 (75%) female) with a mean weight of 70.3 kg (range 40–117 kg; 25% of the patients weighed more than 80 kg) were operated on between May 1990 and August 1991. Their ages ranged from 17 years to 85 years (mean 46 years) and 9% of the patients were over 70 years old. The indication for surgery was biliary colic in 165 patients (79%), acute cholecystitis in 24 (11%), both colic and cholecystitis in

15 (7%) and pancreatitis in 6 (3%). Nine patients (4%) were found to have an empyema due to obstruction of the gallbladder. The mean duration of these symptoms preoperatively was 21 months (range 4 days to 20 years). Eight patients (4%) had a history of pancreatitis and 13 (6%) had a history of jaundice.

ERCP was performed before cholecystectomy in 12% (25/210) of the patients, including those with a history of jaundice. In four patients ERCP was unsuccessful initially; of these four, two had repeat ERCPs, one underwent percutaneous antegrade cholecystography which showed a normal common bile duct, and the other intravenous cholangiography which also demonstrated no stones in the duct. In one patient the ERCP was complicated by a small retroperitoneal air leak, but this did not cause any clinical problems and in all other cases ERCP was uncomplicated.

A total of 46 patients (22%) had undergone previous abdominal surgery and this was not considered a contraindication to LLC. In 32 of these patients the previous surgery had resulted in an incision in the lower abdomen only (paramedian 2, midline 6, Pfannenstiel 15 and gridiron 9) and nine patients had had previous laparoscopic surgery. However, four patients had either midline (2) or paramedian (2) scars in the upper abdomen as a result of previous gastrectomy. Percutaneous removal of a stone in the gallbladder had been performed elsewhere on one of the patients, resulting in a biliary fistula and recurrent stones. Dissolution therapy had failed in three of the patients and in two of these lithotripsy had also been unsuccessful; another patient had been considered unsuitable for lithotripsy because Hartmann's pouch was obstructed by a stone interfering with gallbladder emptying.

Methods

All patients were informed of the risks and benefits of the procedure preoperatively and consent to proceed to open cholecystectomy if necessary was always obtained. The four-port technique of laparoscopic cholecystectomy has been described in detail elsewhere *(10,11)*. Briefly, the patient is placed in a supine position; we no longer insert either a nasogastric tube or urinary catheter routinely. The operating team usually consists of the surgeon, a camera operator, anaesthetist, scrub nurse and circulating nurse.

Using the Veress needle, a pneumoperitoneum is established with CO_2 gas and a 10 mm 0° diagnostic laparoscope is inserted through an umbilical puncture site. The peritoneal cavity is inspected and trocars are inserted under direct vision through three further puncture sites (ports) in the epigastrium, right upper quadrant and right flank. The latter two ports are used for the introduction of grasping forceps to retract the fundus of the gallbladder and Hartmann's pouch.

Blunt forceps are placed through the epigastric port and are used to dissect the cystic artery and duct. These structures are divided between double clips using a multiple-clip applicator inserted through the epigastric port and the gallbladder is then dissected from the liver using the SLT 60 NdYAG contact laser, which produces haemostatic cutting and vaporisation. Throughout the procedure heparinised saline is used to irrigate the operative field and prevent the formation of clots which would be difficult to aspirate at the end of the operation. Once free, the gallbladder is removed through the epigastric incision. After a final inspection of the gallbladder bed and the peritoneal cavity the pneumoperitoneum is released and the wounds are closed with 1 or 2 skin sutures.

All patients were prescribed oral and intramuscular analgesia which was then given as required. Patients were discharged when they were tolerating a normal diet, voiding well and pain was controlled with oral analgesia. No attempt was made to press patients to leave hospital before they felt able to cope at home.

Results

The laparoscopic procedure was completed successfully in 206 patients (98%), but had to be abandoned in favour of open operation in four of the 210 patients (2%). The causes of failure were unsatisfactory visualisation of the gallbladder (1), breakdown of the camera (1), adhesions as a result of previous surgery rendering the procedure impossible (1), and damage to an aberrant segmental bile duct (1). In this last case, laparoscopic division of the duct, from which the gallbladder arose directly, revealed an upward continuation of the duct as a segmental right hepatic duct. The upper end of this small duct was tied off at open operation and the patient made an uneventful recovery.

The majority of the patients (60%) had multiple stones less than 1 cm in diameter; 25% had multiple stones 1–2 cm in diameter; 8% had stones 2–4 cm in diameter and three patients had a 4 cm stone. Eight patients (4%) had only biliary sludge and three patients had no stones. Of these three, one had undergone oral dissolution therapy but had remained symptomatic, another was found to have a hamartoma at the neck of the gallbladder and the third patient was found histologically to have acalculous cholecystitis. In 21 patients (10%) one or more small stones were lost in the peritoneal cavity and in all patients with stones 1 cm or more in diameter either the epigastric or umbilical incisions had to be extended slightly to allow the gallbladder and its stones to be removed.

Operative cholangiography was performed in two patients in order to define the anatomy of the biliary tree; in one of these patients the cholangiogram was unsuccessful because the unusually wide cystic duct could not be occluded with a clip around the cannula.

Operating times were assessed by dividing the patients into four groups: group A (patients 1–50), group B (patients 51–100), group C (patients 101–150) and group D (patients 151–210). The mean operating time for group A was 92 min (range 32–300 min), for group B 86 min (range 40–185 min), for group C 77 min (range 25–200 min) and for group D 73 min (range 25–

180 min). It therefore appears that the operating time has fallen steadily and the times for groups A and D are significantly different (t test $P<0.05$). The mean laser time, which represents the time taken to dissect the gallbladder from the liver, was 23 min (range 4–90 min). In 49 patients (23%) a tube drain was left to the gallbladder bed and removed 12 or 24 h later.

Operative difficulties were encountered in 25 of the patients who underwent successful LLC (25/206; 12%) and there were purely technical problems with the equipment in a further 28 patients (28/206; 14%). Operative difficulties included difficulty in grasping a distended gallbladder, which very occasionally necessitated the enlargement of the right upper quadrant port to accommodate bigger grasping forceps and bleeding from the gallbladder bed which in one patient required the use of a fifth port to enable retraction of the transverse colon inferiorly in order to improve access to the bleeding point. In another patient a separate 2 cm supra-umbilical incision had to be made in order to retrieve a large stone which had fallen out of the gallbladder and could not be manipulated through the umbilical incision. On another occasion the gallbladder was dropped while being manipulated through the umbilical incision and it took 30 min to retrieve it from the pelvis.

In two patients the laser failed and diathermy was therefore used to dissect the gallbladder from the liver. In another 11 patients diathermy was used in addition to the laser in order to achieve haemostasis.

Two patients developed surgical emphysema, and in one this was associated with a pneumothorax requiring a chest drain for 2 days. This latter complication was due to a very high intra-abdominal pressure resulting from incorrect connection of the exhaust tubing to the CO_2 insufflator. Air was used early in the series to cool the laser tip; on one occasion the tip inadvertently entered the liver resulting in an air embolus in one patient. The patient suffered a sudden fall in oxygen saturation; the pneumoperitoneum was released and 100% oxygen administered with rapid and complete recovery *(12)*. Subsequently the laser tip was cooled using CO_2 gas.

In the postoperative period most patients (57%) required only oral analgesia although intramuscular analgesia was available if required.

Details of the length of hospital stay were available in 184 patients (88%). The great majority of the patients (80%; 148/184) left hospital within 48 h of the operation. A further 11% (20/184) left between 60 h and 72 h postoperatively and eight patients (4%) were in hospital for 4 days. Three patients had a reactionary haemorrhage from the gallbladder bed after LLC. Of these three, one did not require a laparotomy and left hospital 7 days postoperatively; the other two required laparotomy within 24 h of LLC and left hospital 6 days and 10 days after the original procedure (Fig. 1). The four patients in whom LLC was abandoned in favour of open operation left hospital between 5 and 12 days postoperatively.

Of the patients who underwent successful LLC, 130 (63%) were asked how long after the operation they had been able to return to normal activities—whether this be

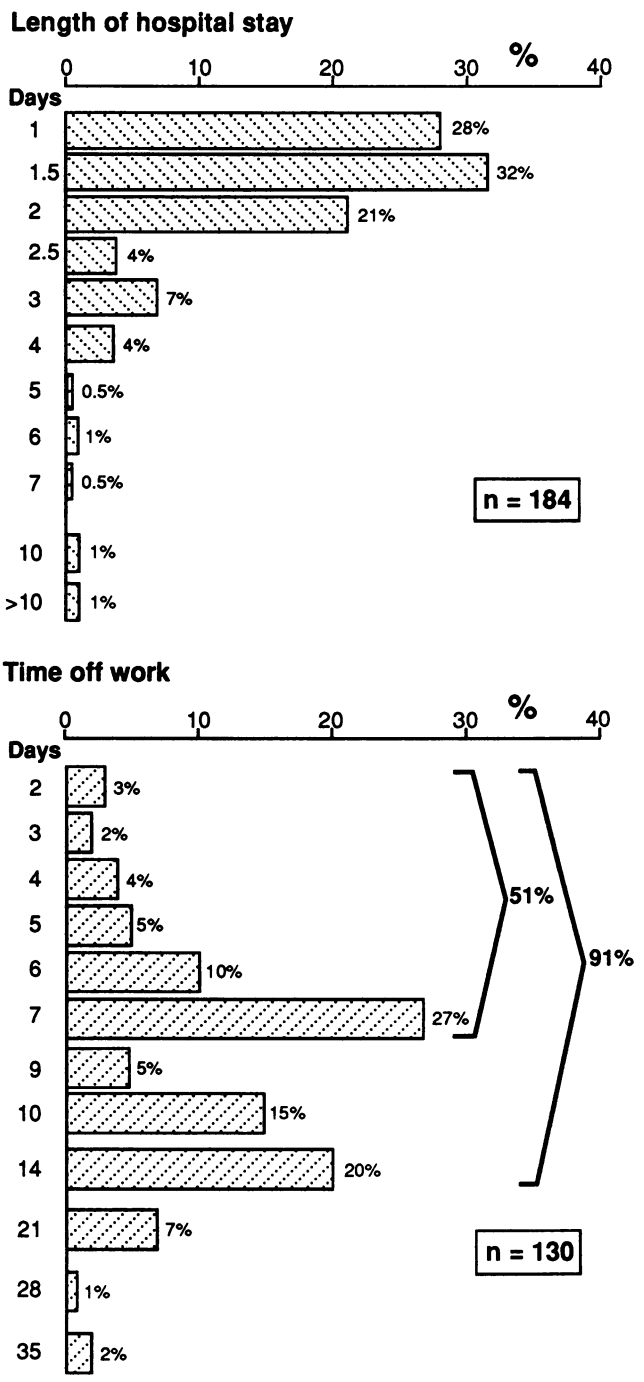

Figure 1. Length of hospital stay and period of absence from work.

work, shopping, housework or travelling: 51% (66/130) had returned to full normal activities within 1 week of the procedure and 91% (118/130) within 2 weeks. All but five patients who had LLC had returned to normal activities within 3 weeks of the operation (Fig. 1), and two of those who stayed off work for 3 weeks said they had only done so at the insistence of their general practitioner.

Postoperative complications developed in 33 patients (33/206; 16%). These were minor in 26 patients consisting of small areas of cellulitis around either umbilical or

lateral incisions (11 patients), pyrexia (6 patients), respiratory complications (3), shoulder-tip pain (3) and urinary retention requiring catheterisation (2). One patient needed a blood transfusion postoperatively. All of these problems resolved within 3 days of the operation.

However, major complications occurred in 7 patients (7/206; 3%). Three patients (3/206; 1.5%) had a reactionary haemorrhage from the gallbladder bed. In the first case it was possible to aspirate the haematoma laparoscopically; in the other two cases laparoscopic aspiration was unsuccessful and laparotomy was needed to evacuate the haematoma; subsequent recovery was uneventful.

Two patients developed serious wound sepsis postoperatively requiring further surgery. One of these patients was an elderly man on steroid therapy for connective tissue disease whose wound abscess had to be drained and who subsequently left hospital 5 weeks after LLC. The other patient was a diabetic woman who required extensive excision of necrotic subcutaneous tissue and eventually left hospital 6 weeks after LLC.

One patient developed urinary retention and ultimately required transurethral prostatectomy. One patient became jaundiced 6 days after LLC owing to a stone at the lower end of the common bile duct; endoscopic sphincterotomy was performed and the stone was extracted without further complication.

Discussion

Although the first laparoscopic cholecystectomy was performed by Mouret in Lyon in 1987, it was McKernan and Saye who first used the laser to dissect the gallbladder from the liver in 1988 and their results in a series of six patients were published the following year *(11)*. The technique is now established in a number of centres in the USA, Europe and the UK *(10,13)*. The benefits claimed for the procedure include a shorter hospital stay leading to reduced costs, less pain and a shorter period of convalescence *(13,14)*.

The results reported here fully support these claims, with 80% of patients leaving hospital within 48 h and 91% returning to normal activities within 2 weeks. By contrast, it has been reported that, in a series of 115 patients who had had open cholecystectomy, 62% were unable to return to work or normal household activity within 6 weeks of operation *(15)*. In the early part of the series we were fearful of discharging patients too soon and undoubtedly many more of our patients now go home at 24 h. The failure rate of 2% compares well with experience in other centres and may be reduced as experience of the procedure increases. For example, the patient who required open cholecystectomy early in the series because of poor visualisation of the gallbladder would almost certainly have undergone LLC successfully later in the series, and the patient who had an open operation because of camera failure underlined the need for readily available skilled technical help.

The laser is an expensive but valuable aid to LLC. We have found it to be more precise than diathermy and less likely to perforate a thin-walled gallbladder. However, diathermy has been more effective for cutting thick and inflamed tissue and we have used both methods to dissect the gallbladder from the fossa.

Although operative cholangiography can be performed during laparoscopic surgery *(11)* the value of routine cholangiography *(16)*, even during open surgery, is doubtful *(17,18)*. Although routine cholangiography has been shown to reveal unsuspected duct stones in 3–14% of patients undergoing elective open cholecystectomy *(19–21)*, 2–12% of cholangiograms give false-positive results resulting in unnecessary duct exploration *(22,23)*. Even if duct stones are missed at operation it is likely that many either pass spontaneously or remain asymptomatic, since large series of cholecystectomies without cholangiography have been reported with an incidence of residual duct stones of only 0.2% *(17,24)*.

However, since it has been shown that abnormal liver function tests or a history of jaundice or pancreatitis are reliable indicators of common duct stones *(25)*, our policy has been to perform selective preoperative ERCP and endoscopic sphincterotomy, as necessary, in all such patients. This policy is also practised by others *(26)*. We have not performed routine operative cholangiography to identify duct stones and would not regard common duct stones as an indication for laparotomy. We therefore only consider performing operative cholangiography when the anatomy of the biliary tree is unclear; in this situation a successful cholangiogram may spare the patient a laparotomy.

The time taken to perform LLC appears to have fallen throughout the period of this study, but the impact of this procedure will be to increase the need for operating time and decrease the need for inpatient beds by reducing the hospital stay. Considerable delays between laparoscopic procedures on an operating list can be reduced by providing more than one set of laparoscopic instruments.

The shorter hospital stay, consequent reduced costs and shorter time off work associated with LLC as compared to open cholecystectomy make it a more attractive operation than conventional cholecystectomy. It is therefore likely that great pressures—social, political and financial—will be brought to bear on surgeons in all districts to offer this technique. The facilities for training in the new technique should be available to surgeons with adequate experience in conventional biliary surgery and it has been suggested that approved training courses should provide hands-on experience in diagnostic laparoscopy, extensive use of the Berci/Sackier laparoscopic trainer and experience with the procedure in animals *(27)*. While some of these recommendations are impractical, there is no doubt that proper training is essential before undertaking this procedure *(14)*, and both surgeons and administrators should adopt a responsible attitude towards this.

We believe that laparoscopic cholecystectomy is now the procedure of choice when surgery is indicated for gallbladder stones. All patients who need cholecystectomy should now be advised of the options available to

them and of the potential benefits of the laparoscopic procedure.

References

1 Langenbuch K. Removal of the gallbladder with chronic cholecystitis. *Berl Klin Wschr* 1882;**48**:725.

2 Gilliland TM, Traverso LW. Modern standards for comparison of cholecystectomy with alternative treatments for symptomatic cholelithiasis with emphasis on long-term relief of symptoms. *Surg Gynecol Obstet* 1990;**170**:39–44.

3 Sackmann M, Delius M, Sauerbruch T *et al.* Shock wave lithotripsy of gallbladder stones: the first 175 patients. *N Engl J Med* 1988;**318**:393–7.

4 Allen MJ, Borody TJ, Bugliosi TF, May GR, LaRusso NF, Thistle JL. Cholelitholysis using methyl tertiary butyl ether. *Gastroenterology* 1985;**88**:122–5.

5 Schoenfield LJ, Lachin JM. Steering Committee, The National Cooperative Gallstone Study Group. Chenodiol (chenodeoxycholic acid) for dissolution of gallstones: a controlled trial of efficacy and safety. *Ann Intern Med* 1981;**95**:257–82.

6 Cope C, Burke DR, Meranze SG. Percutaneous extraction of gallstones in 20 patients. *Radiology* 1990;**176**:19–24.

7 Kellet MJ, Wickham JEA, Russell RCG. Percutaneous cholecystolithotomy. *Br Med J* 1988;**296**:453–5.

8 Akiyama H. Okazaki T, Takashima I *et al.* Percutaneous treatments for biliary diseases. *Radiology* 1990;**176**:25–30.

9 McSherry CK. Cholecystectomy: the gold standard. *Am J Surg* 1989;**158**:174–8.

10 Dubois F, Icard P, Berthelot G, Levard H. Coelioscopic cholecystectomy. Preliminary report of 36 cases. *Ann Surg* 1990;**211**:60–62.

11 Reddick EJ, Olsen DO, Daniell JF *et al.* Laparoscopic laser cholecystectomy. *Laser Med & Surg News and Advances* 1989;**71**:38–40.

12 Greville AC, Clements EAF. Pulmonary air embolism during laparoscopic laser cholecystectomy. *Anaesthesia* 1991 (in press).

13 Perissat J, Collet DR, Belliard R. Gallstones: laparoscopic treatment, intracorporeal lithotripsy followed by cholecystostomy or cholecystectomy—a personal technique. *Endoscopy* 1989;**21**:373–4.

14 Cuschieri A, Berci G, McSherry CK. Laparoscopic cholecystectomy, Editorial. *Am J Surg* 1990;**159**:273.

15 Bates T, Mercer JC, Harrison M. Symptomatic gallstone disease: before and after cholecystectomy. *Gut* 1984;**25**: 579–80.

16 Kelley CJ, Blumgart LH. Peroperative cholangiography and postcholecystectomy biliary strictures. *Ann R Coll Surg Engl* 1985;**67**:93–5.

17 Gerber A, Apt MK. The case against routine operative cholangiography. *Am J Surg* 1982;**143**:734–6.

18 Pernthaler H, Sandbichler P, Schmid Th, Margraiter R. Operative cholangiography in elective cholecystectomy. *Br J Surg* 1990;**77**:399–400.

19 Jolly PC, Baker JW, Schmidt HM, Walker JH, Holm JC. Operative cholangiography: a case for its routine use. *Ann Surg* 1968;**168**:551–65.

20 Pagana TJ, Stahlgren LH. Indications and accuracy of operative cholangiography. *Arch Surg* 1980;**115**:1214–15.

21 Schulenberg CAR. Operative cholangiography: 1000 cases. *Surgery* 1969;**65**:723–39.

22 Stark ME, Loughry CW. Routine cholangiography with cholecystectomy. *Surg Gynecol Obstet* 1980;**151**:657–8.

23 Seif RM. Routine operative cholangiography: a critical appraisal. *Am J Surg* 1977;**134**:566–8.

24 Cassie GF, Kapadia CR. Operative cholangiography or extraductal palpation: an analysis of 418 cholecystectomies. *Br J Surg* 1981;**68**:516–17.

25 Hauer-Jensen M, Karesen R, Nygaard K *et al.* Consequences of routine peroperative cholangiography during cholecystectomy for gallstone disease: a prospective, randomised study. *World J Surg* 1986;**10**:996–1002.

26 Coleman J, Paul A, Spangenberger W, Klein J, Troidl H. Operative cholangiography in elective cholecystectomy. *Br J Surg* 1990;**77**:1074.

27 Airan MC. Letter to the editor. *Am J Surg* 1990;**159**:619.

Received 18 October 1991