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Laparoscopic laser cholecystectomy: our first 200 patients

Michael J Hershman MS FRCS
Senior Surgical Registrar

R David Rosin MS FRCS
Consultant Surgeon

Department of Surgery, St Mary's Hospital, London

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A series of 200 consecutive patients were considered for laparoscopic laser cholecystectomy. Laparoscopic laser cholecystectomy was attempted in 195 cases and was performed in 192 cases. Laparoscopy was performed in five patients, but laparoscopic cholecystectomy was not attempted owing to dense adhesions (3), cholangiocarcinoma (1) and an absent gallbladder (1).

The indications for operation were symptomatic gallstones which included biliary colic (142), acute cholecystitis (49) and gallstone pancreatitis (9). The median duration of operation was 75 min. Operative cholangiography was attempted in 151 (77%) of cases, and was successful in 85% of attempts. Laparoscopic common bile duct visualisation was performed three times with successful stone extraction twice. The other common bile duct was normal. The median duration of postoperative hospital stay was 2 days, for return to normal activity 6 days, and for return to work 10 days. Mean analgesic and antiemetic requirements were approximately one-third of those for open cholecystectomy. Of the patients, 94% reported good or excellent overall satisfaction and 96% reported excellent cosmetic results.

Seven complications occurred (4%). Three patients had immediate conversion to laparotomy owing to haemorrhage (2) and gallbladder rupture (1). Four patients required laparotomy for postoperative complications (common bile duct damage, slipped clips from cystic duct, perforated duodenum and leaking accessory hepatic duct). No complications occurred in the last 140 cases.

These data suggest that laparoscopic laser cholecystectomy reduces the discomfort of laparotomy and allows a shorter postoperative recovery. The operation has a learning curve, but will ultimately be applicable to the majority of patients with symptomatic gallstones.

Correspondence to: Mr M J Hershman, 111 Middleton Road, London Fields, Hackney, London E8 4LN

Cholelithiasis is one of the most common diseases in the Western World, with a prevalence of between 5% and 22% *(1–6)*. Cholecystectomy is the accepted method of treatment for symptomatic gallstones. Alternative treatments for gallstones have recently been advocated including lithotripsy, stone dissolution and percutaneous stone removal *(7)*. However, all of these approaches leave the gallbladder *in situ*, making stone recurrence possible. Laparoscopic cholecystectomy is the most promising new technique for the treatment of symptomatic gallstones.

In England, open cholecystectomy remains the most common elective abdominal operation, with over 30 000 performed each year *(8)*. In a number of centres in North America and Europe, laparoscopic cholecystectomy has recently become firmly established as the operation of choice *(9–12)*. The advantage of the laparoscopic approach is reduction of the trauma of access without compromise to the exposure of the operative field. This enables accelerated patient recovery and reduction of wound-related complications. Advocates of laparoscopic cholecystectomy report less postoperative pain, shorter hospital stay and quicker return to work when compared with conventional open procedures *(10)*.

In the United Kingdom, a number of centres are now practising laparoscopic cholecystectomy routinely. In this paper we report our experience of our first 200 consecutive patients with symptomatic gallstones who were considered for laparoscopic laser cholecystectomy.

Methods

A series of 200 consecutive patients under the care of the senior author agreed to undergo laparoscopic laser cholecystectomy (LLC). All patients consented to undergo conversion to open operation if necessary. The indica-

tions for LLC were symptomatic gallstones; this included both elective cases and emergency cholecystectomy for acute unresolving cholecystitis. Contraindications to LLC were unsuitability for general anaesthesia and late pregnancy.

Preoperative endoscopic retrograde cholangiopancreatography (ERCP) was performed if there was a history of jaundice longer than 2 days, if liver function tests were abnormal or if the common bile duct (CBD) was greater than 10 mm in diameter on ultrasound. All patients with CBD stones discovered preoperatively had ERCP.

All patients had general anaesthesia with endotracheal intubation. The urinary bladder was catheterised, emptied and the catheter removed preoperatively. A nasogastric tube kept the stomach and duodenum empty throughout the procedure and was removed at the end of the operation. Three-dose antibiotic prophylaxis with cefuroxime and metronidazole was used starting at induction of anaesthesia.

The patient was placed in the supine position with the surgeon and the camera operator on the left side and the assistant on the right. Pneumoperitoneum was established with the patient placed in the Trendelenburg position using carbon dioxide via a Veress needle inserted subumbilically. A crescentic umbilical incision was used to insert a 10 mm laparoscope (0° angle of view) attached to a video camera. More recently we have used a vertical umbilical incision. In patients with umbilical scars a direct cut down was used to insert the laparoscope. The patient was then placed in a reverse Trendelenburg position with left rotation.

The positions of the secondary cannula sites are shown in Fig. 1. Adhesions were divided with a Nd Yag laser or diathermy if necessary. The gallbladder was grasped by forceps inserted through the 5 mm lateral port and retracted cephalad. Dissection was performed by a two-handed technique using instruments passed through the 5 mm midclavicular port and the 10 mm midline port. When the cystic duct and artery were demonstrated, a clip applicator (multiple endoclip applicator, Autosuture®) or more recently absorbable polydioxanone clips (Absolok®, Ethicon) *(13)* were used to clip these structures. It was general policy to perform operative cholangiography. The reasons for not performing cholangiography and for cannulation failure were recorded. In three patients the common bile duct was visualised using a flexible laryngoscope inserted through the cystic duct. The flexible laryngoscope was passed down the midclavicular port and inserted into the cystic duct using Petelin forceps. The gallbladder was then removed from its bed using a Nd Yag laser *(10,14)*. The liver bed was examined for haemostasis before complete removal. The gallbladder was then removed via the umbilical port. A Redivac® drain was placed in the subhepatic region via the lateral port. Any technical difficulties encountered were recorded.

During the operation irrigation was performed using saline containing 20 ml of 0.5% bupivacaine. More recently we have inserted bupivacaine in the subhepatic region at the end of the procedure. The fascia at the umbilical and epigastric port was closed with Vicryl®. The skin was closed with subcuticular nylon.

Postoperatively, the opiate requirement (Omnopon®) and antiemetic requirement (metoclopramide) were recorded. The total volume of drainage and time of drain removal were also recorded. Patients were discharged when they were comfortable.

All patients were reviewed 6 weeks postoperatively and were asked to complete a questionnaire. They were asked to evaluate, on a scale of 1 to 5, overall satisfaction, pain control and cosmetic result. In addition they were asked when they returned to normal activity and work, if appropriate.

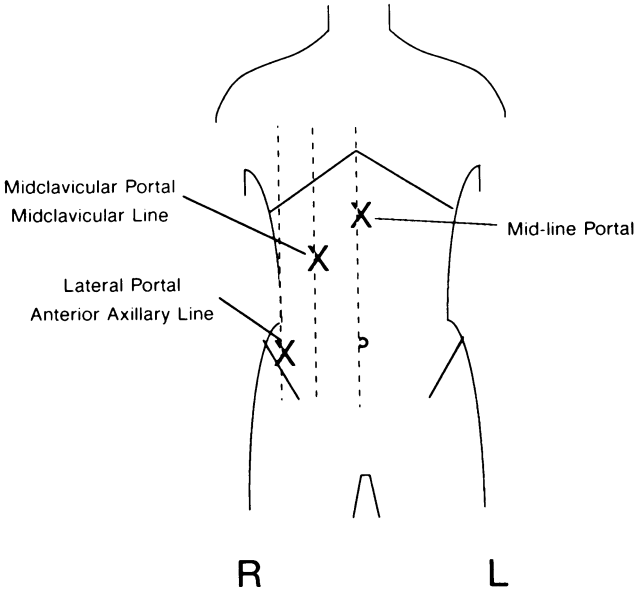

Figure 1. Secondary trocar sites for laparoscopic cholecystectomy. A 10 mm cannula is used at the midline portal and 5 mm cannulas are used at the midclavicular and lateral portals.

Results

A total of 200 patients agreed to undergo laparoscopic cholecystectomy, and the patient details are summarised in Table I. Of these patients, 78 had had previous

Table I. Patient details

Number of patients: 200 (146 female, 54 male)
Age: Median 49 years (range 19–86 years)
Weight: Median 68 kg (range 39–153 kg)
Previous abdominal surgery: 78 patients (39%)
Gallstone disease:
Biliary colic, 142
Acute cholecystitis, 49
Gallstone pancreatitis, 9
Preoperative jaundice: 23 (10 had ERCP)
Normal ERCP, 5
CBD stone extraction, 5

laparotomies (39%) through either paramedian or midline incisions. Preoperative ERCP was performed in 10 patients of whom five had sphincterotomy and common bile duct stone extraction. One patient had transient mild acute pancreatitis which settled within 4 days. Postoperative ERCP was performed in one patient (congenitally absent gallbladder).

Laparoscopic laser cholecystectomy was attempted in 195 (98%) of patients. In the remaining five patients the procedure was not attempted owing to dense adhesions from previous upper gastrointestinal surgery (3), cholangiocarcinoma (1) or a congenitally absent gallbladder (1) (Table II). Gallstones were present in all cases except the congenitally absent gallbladder. In this case the preoperative ultrasound scan had been misinterpreted as a shrunken gallbladder containing stones.

Technical difficulties were reported in 61 operations (31%) and are outlined in Table II. Three of these technical difficulties caused the surgeon to convert the procedure into a laparotomy (2%). Two cases were uncontrollable haemorrhage and the third was rupture of the gallbladder on removal with spillage of bile, gallstones and gallbladder fragments (Table III). These three cases occurred in the first 50 patients.

The median operating time was 75 min (range 29–300 min) and reduced by a median of 20 min in the second 100 patients (69 min) compared with the first 100 patients (89 min). The median laser time was 10 min (range 4–35 min).

Operative cholangiography was attempted in 151 cases (77%) and was successful in 129 of these cases (85%). It was not attempted in 44 patients for the reasons outlined in Table IV. The common bile duct was visualised using a flexible laryngoscope in three cases. In one, stones were removed using a Dormia® basket, and in another a stone was pushed into the duodenum using the laryngoscope. In the third case no stones were seen. A total of seven patients (4%) had stones in the common bile duct, five had stones removed by preoperative ERCP and two by laparoscopic techniques.

There was no mortality, but seven complications occurred (4%), all of which required laparotomy (Table III). Three patients had immediate conversion to laparotomy as described above. A further four patients required laparotomy in the postoperative period. All complications occurred in the first 60 patients. In one case an unrecognised duodenal injury occurred, which had it been recognised could have been sutured laparoscopically now that we have greater experience. Persistent bile leak occurred in the other three patients; this was due to an unrecognised accessory hepatic duct in one case, and to slipped clips from the cystic duct in another. In both cases the ducts were sutured at subsequent laparotomy. Common bile duct injury occurred in the other case, and this required formal repair by choledochojejunostomy.

The postoperative course of all patients, including the three laparotomy conversion patients but excluding the four postoperative complications, is outlined in Table V. The mean analgesic and antiemetic requirements are

Table II. Operative difficulties

Non-proceeds, 5 patients (3%)	
Dense adhesions	3
Cholangiocarcinoma	1
Absent gallbladder	1
Technical difficulties, 61 patients (31%)	
Dense adhesions	24
Stone too large for incision	10
Laser difficulty	8
Haemorrhage	6
Abnormally sited cystic artery	5
Gallbladder rupture on removal	4
Insufflator difficulty	4

Table III. Complications

Total	7 (4%)
Immediate laparotomy	3 (2%)
Haemorrhage	2
Rupture of gallbladder	1
Postoperative complications	4 (2%)
Common bile duct damage	1
Slipped clips from cystic duct	1
Perforated duodenum	1
Leaking accessory hepatic duct	1

Table IV. Operative cholangiography

Performed	
151 attempted (77% of LLCs)	
129 successful (85% of attempts)	
Not performed	
22 cannulation failure (15% of attempts)	
44 not attempted (23% of LLCs)	
Single large calculus	31
Previous ERCP	10
Empyema	3

Table V. Postoperative course

Hospital stay
Analgesic requirement: mean 0.29 mg/kg, SD 0.33 mg/kg (34% required no analgesia)
Antiemetic requirement: mean 0.12 mg/kg, SD 0.08 mg/kg (31% required no antiemetic)
Drainage: median 27 ml (range 0–210 ml) (35% had 0 ml, 77% drains removed by 24 h)
Duration of hospital stay: median 3 days (range 1–12 days)
Duration of postoperative stay: median 2 days (range 1–11 days)
After discharge
Return to normal activity: median 6 days (range 1–28 days)
Return to work: median 10 days (range 2–21 days) (39% did not work)

Table VI. Patient evaluation

	Excellent	*Good*	*Average*	*Poor*	*Terrible*
Pain experience	32%	44%	22%	2%	0%
Cosmetic result	96%	0%	0%	2%	2%
Overall evaluation	89%	5%	2%	1%	2%

approximately one-third of those of 'open' cholecystectomy patients treated at our hospital. This comparison is based on the last 20 open cholecystectomy patients. The median total hospital stay was 3 days, and the median postoperative stay was 2 days. Only 43 patients were admitted on the day of their operation. Of the patients, 89% were discharged during the first 3 postoperative days. The median time to return to normal activity was 6 days, and the median time to return to work was 10 days. One patient returned to work on the second postoperative day!

The evaluation of the operation by all 200 patients is shown in Table VI. Of the patients, 94% reported good or excellent overall satisfaction and 96% reported an excellent cosmetic result. Not surprisingly, patients who reported poor or terrible satisfaction were patients who had complications. Four patients (2%) reported poor pain experience and these were all patients who had not had previous surgery and who had uneventful operations and recoveries.

Discussion

Our initial experience with laparoscopic laser cholecystectomy has been encouraging and rewarding, particularly in patient recovery and the reduction of wound-related complications.

The difficulties in setting up a clinical trial of conventional versus laparoscopic cholecystectomy have recently been highlighted *(15)*. Indeed, many patients included in this study specifically requested laparoscopic cholecystectomy and would certainly not have agreed to be randomised. Notwithstanding these difficulties, both the analgesic and the antiemetic requirements of patients in this study were approximately one-third that of patients who had previously undergone conventional open cholecystectomy in our hospital. In addition, the median duration of postoperative stay of 2 days for laparoscopic cholecystectomy patients compares favourably with that of 5–7 days for conventional cholecystectomy patients. Finally, laparoscopic cholecystectomy patients took 6 days to return to normal activity and 10 days to return to work, compared with about 4 to 6 weeks for open cholecystectomy patients.

Patients were generally very satisfied with the operation. In 94% the procedure was evaluated as good or excellent and 96% said the cosmetic result was excellent. Not surprisingly, the few who were dissatisfied were those who had complications. In all, 76% reported that their pain relief was good or excellent, with only 2% reporting poor pain control.

Laparoscopic laser cholecystectomy, therefore, has clear advantages in terms of comfort, rate of recovery and cost of treatment compared with conventional cholecystectomy. It has been estimated that if the 30 000 cholecystectomies performed annually in England were performed laparoscopically, the cost saving resulting from a reduction in bed days alone would amount to £21 million *(16)*. However, this is a superficial analysis and does not consider the increased costs of the operating theatre and medical staff.

Like any new operation there is a learning curve. We believe this is reflected in the operating times. Our median overall operating time was 75 min; however the median operating time of the second 100 patients was 20 min less than the first 100 patients (69 and 89 min, respectively). Of the five patients in whom we did not proceed to laparoscopic cholecystectomy, three had dense adhesions, and all of these patients were among the first 50 patients. We believe that with greater experience these adhesions could have been divided via laparoscopic techniques. This is evidenced by the fact that subsequently 24 patients with technically difficult dense adhesions had successful procedures performed (Table II). The other two patients had a cholangiocarcinoma and an absent gallbladder, neither of which could have been anticipated preoperatively.

Similarly, the three patients who had immediate conversion to laparotomy for haemorrhage (2) and gallbladder rupture (1) were among the first 60 patients. Four subsequent patients with 'technically difficult' haemorrhage and three with gallbladder rupture on removal had to undergo successful laparoscopic procedures (Table II). It is therefore possible that with greater experience our three immediate laparotomy conversion patients may have been able to undergo successful laparoscopic procedures. We regard these problems also as a part of our learning curve and emphasise that during this period a cavalier attitude must not be adopted. Safety has to be of prime importance rather than speed or prolonged persistence.

We had four postoperative complications that required subsequent laparotomy. All complications occurred early in our experience. It is difficult to believe that the perforated duodenum would have been missed at open operation. If it had been recognised at laparoscopic cholecystectomy it could have been sutured laparoscopically. In one patient, two clips slipped off the cystic duct and a biliary peritonitis resulted. Kempeneers has reported slipped clips and suggests that a possible reason is that they may not have been applied at 90° to the cystic duct *(17)*; therefore, perhaps this was an avoidable complication. Another patient had a leaking accessory hepatic duct. This is a complication that can occur after open cholecystectomy and cannot be regarded as a specific complication of laparoscopic cholecystectomy. Such injuries can only be minimised by assiduous attention to detail during dissection *(18)*.

One patient had common bile duct damage, and this is the complication of most concern. This complication has occurred in up to 1% of published series *(9,15,17,18)*.

The possible reasons include damage during dissection, local pressure necrosis from clips placed too close to the common bile duct, and necrosis from thermal injury with monopolar current *(17)*. Our patient subsequently required a choledochojejunostomy.

It was our policy to perform operative cholangiography, and our success rate was 85%. Cannulation failures were usually due to narrow cystic ducts. The arguments for and against operative cholangiography at conventional cholecystectomy probably apply equally to laparoscopic cholecystectomy *(19,20)*. We felt that in addition to providing a map of the anatomy and detecting ductal stones, it was useful on occasions in showing the safe point at which the cystic duct could be clipped. In addition, we thought it important to become proficient in operative cholangiography, so that we could confidently perform it in difficult cases. More recently we have pursued a more selective policy, not performing cholangiography in patients with single large stones. Certainly operative cholangiography adds approximately 20 min to the length of the operation *(9)*.

Similarly, the arguments for and against routine drainage of open cholecystectomy apply equally to laparoscopic cholecystectomy. It was our policy to drain these cases routinely. It is our belief that a few hours of suction drainage reduces postoperative diaphragmatic irritation from laser or diathermy smoke. To aid this further we gave intraperitoneal bupivacaine routinely at the end of the operation. Clearly, determination of the efficacy of this practice will require a clinical trial.

Another unresolved problem is the management of common bile duct calculi discovered at laparoscopic cholecystectomy *(9)*. In this series we visualised the common bile duct three times using a flexible laryngoscope inserted into the cystic duct. We were able to extract a stone using a Dormia basket in one case and in another we pushed a stone into the duodenum. No stones were found in the third case. Petelin has currently explored common bile ducts directly and repairs it by suturing at the end of the procedure (personal communication). The role of laparoscopic CBD exploration is yet to be evaluated.

It was our policy to use the laser for dissection rather than diathermy. We experienced technical problems with the laser in eight cases (Table II) and converted to diathermy dissection. There are proponents of both laser and electrocautery for excising the gallbladder from its bed *(10,14,21)*. As yet there are no prospective data to answer the question of superiority *(22)*. It is our belief that the laser gives a more precise, cleaner dissection than diathermy, particularly where adhesions need to be divided.

Laparoscopic cholecystectomy avoids the discomfort of laparotomy and allows a shorter postoperative recovery. Overall, we feel that the complications of laparoscopic cholecystectomy compare favourably with those of open cholecystectomy *(17,18,23)*. We note that no complications at all occurred in our last 140 patients. We suggest that laparoscopic cholecystectomy should be considered for all patients undergoing cholecystectomy.

Finally, cholecystectomy is only one of a variety of new minimally invasive surgical techniques. These techniques will clearly be increasingly used by the general surgeon for a wide variety of indications *(24)*.

Addendum

Since the writing of this paper, the Committee for the Safety of Medicine has recommended that Omnopon should not be used for women of child-bearing age. We are currently using pethidine.

We were the first centre in England and Wales to perform this procedure. Since writing this paper we have performed 200 more operations without any complications. We have used different modalities to dissect the gallbladder—diathermy, hydrodissection and the harmonic scalpel.

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