

How to Secure Cystic Duct Ligation for Laparoscopic Cholecystectomy - Back to Simple Basic

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Abstract

Background: Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic gallstone. There have been many techniques of cystic duct ligation reported but there are still many complications due to failure of this ligation. The present study reviewed the outcome of LC performed whereby cystic duct and artery were ligated by an ordinary silk.

Materials and Methods: This retrospective study reviewed the overall outcome of 121 patients who underwent LC whereby cystic duct and artery were intracorporeally ligated by simple silk. The procedures had been performed during May 2002- December 2005. The following parameters were analyzed: age, sex, weight, underlying diseases, previous surgery, diagnosis, anatomy of hepatobiliary system, operation time, length of stay (LOS), the numbers of intracorporeal knots, complications and follow-up time.

Results: Of 121 patients, 2 patients (1.6%) were converted to open cholecystectomy. The mean age was 53.04 years and the average body weight was 59.45 kg. Ninety three patients (76.9%) were female and 28 patients (23.1%) were male. The most common diagnosis was symptomatic gallstones without cholecystitis (86.7%). Gallstones with chronic cholecystitis were found in 8.3%. The average operative time was 61.29 minutes (25-160). The average LOS was 3.05 days and the average number of intracorporeal knots was 5.12 for each patient. There were 12 patients who had complications in which the most common was bleeding in 5 patients (4.1%). Intra-abdominal collection (bile leakage) occurred in one patient (0.8%) and this patient needed re-admission. There was no main biliary duct injury and mortality.

Conclusion: The intracorporeal ligation of LC was feasible, economical and safe and it could manage all kinds of cystic ducts. The author suggested the important steps to avoid complications: 1) keep standard 4-port technique (3 of 5 mm. and 1 of 10 mm.), 2) first dissect posterior peritoneum of the Calot's triangle, 3) create two windows over the Calot's triangle, 4) use intracorporeal knotting, and 5) meticulously dissect to look for anatomical variations.

Key words: cystic duct, ligation, laparoscopic cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the gold standard surgical treatment for gallbladder diseases. The techniques for LC have been modified to facilitate the procedure and to avoid complications. LC was performed in this hospital since 1995 and until now

there have been almost one thousand patients undergoing this operation. Various literatures^{1,2} showed multiple complications including clip failure (dislodge, slippage or migration), bile leakage and common bile duct (CBD) injury. Most studies^{3,4} mentioned the employ of absorbable suture materials for intracor-

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poreal knotting while some reports⁵ described manual ligation using ordinary silk sutures. After gaining more experience the author began to modify cystic duct ligation by using simple silk in order to reduce such morbidity and manage all kinds of difficult cystic ducts.

MATERIALS AND METHODS

During July 2002-December 2005 there were 137 patients in whom cholecystectomy was performed at the Fort Prajaksilapakom Hospital by a single laparoscopic surgeon (the author). Among these, 9 patients were excluded from this study due to conversion to open surgery (8 patients with CBD stone requiring open exploration of CBD, 1 patient with choledochal cyst requiring hepaticojejunostomy anastomosis) and 6 patients who had cystic duct and artery controlled by conventional clipping. Finally there were 121 patients in this study. The author retrospectively reviewed the medical record for the following data categories: gender, age, weight, length of stay (LOS), underlying diseases, diagnosis, previous operation, operative time, number of knots in each patient, type of drain if applied, anatomy of hepatobiliary system, complication and follow-up time.

General anesthesia was applied for all patients. The author used the 4-port technique consisted of 3 of 5 mm. trocars for hand instruments and 1 of 10 mm. trocar for telescope. All trocars were reusable including hand instruments. The surgeon stood on the left side of the patient and used two-hand technique. The first umbilical port was always punctured by direct vision (open technique). The intra-abdominal pressure was limited at 15 mm.Hg by CO₂ insufflation. The fundus of GB was pulled cephalad by the most lateral port. The infundibulum of GB was grasped and pulled laterally via the midclavicular port to expose Calot's triangle. The surgeon started dissection at posterior peritoneum of Calot's triangle and then anterior peritoneum to create two windows. The first one was between cystic duct and cystic artery in the classical anatomy of the Calot's triangle. The other one was between cystic artery and right hepatic duct or inferior surface of liver. To knot cystic duct, the 2-0 silk was introduced from epigastric port and the first loop needed 2 rounds. These first 2 round loop was less likely to loose and the next 2 loops needed just one round (Fig. 1-3). After finishing knot a surgeon should obviously see the constricted cystic duct (shoulder appearance as Fig. 4). In contrary, to knot cystic artery the first loop required just one round.



Figure 1



Figure 2



Figure 3



Figure 4

The resected gall bladder was taken out via umbilical port. Jackson-Pratt drain was placed subhepatic area in case of needed drainage and the other end was taken out per the anterior axillary line port.

The author used the selective criteria for intraoperative cholangiogram (IOC). This was performed by advancing small feeding tube no. 3.5 through Roddick-Oldsen clamp under fluoroscope (C-arm).

RESULT

LC were successfully performed in 119 patients but 2 patients (1.6%) were converted to open surgery. There were 93 females (76.9%) and 28 males (23.1%). The mean age was 53.04 years old (26-79). The average weight was 59.45 kgs. The details of diagnosis on 137 cholecystectomy were shown in Table 1.

There were 2 patients who had the second principal diagnosis which was inguinal hernia and

Table 1 Details of diagnosis

Diagnosis	Number of cases
Gall stones without cholecystitis	108
Gall stones with chronic cholecystitis	10
CBD stone	8
GB polyp	4
Acute cholecystitis	2
Acute gall stone pancreatitis	1
Chronic cholecystitis (without stone)	1
Gall stone with liver masses	1
Choledochal cyst	1
Adenocarcinoma of gall bladder	1
Total	137

Table 2 Details of underlying diseases

Underlying diseases	Number of cases
Hypertension	21
Diabetes mellitus	18
Thalassemia	3
Asthma	2
Chronic obstructive pulmonary disease	1
Chronic renal failure	1
Atrial fibrillation	1
Benign prostate hyperthropy	2
Ishemic coronary disease	1
Thrombocytopenia	1

concurrent laparoscopic herniorrhaphy were performed. Some of 121 patients had underlying diseases as shown in Table 2.

There were 15 patients who had previous abdominal operations as shown in Table 3. In 6 patients who had caesarian section, there were 4 patients with low midline surgical scar. All of TAH patients had low midline scar.

Of 119 patients the average operation time was 61.29 minutes (25-160). LOS was 3.05 days. The average number of knots was 5.12 in each patient. Some patients needed just 3 knots for both cystic duct and artery ligation because cystic duct and artery were held together. It was unnecessary to ligate duct and artery separately. From this study individual knot took 1.50 minutes. Generally knots of specimen side took much shorter time than the patients side did. Jackson-Pratt drains were placed in 7 patients.

Regarding the anatomy of hepatobiliary system there were 9 patients showing macronodular surface of liver and the procedure had to be done carefully. These and other findings were classified as difficult laparoscopic cholecystectomy (Table 4).

Intraoperative cholangiography (IOC) were done in 5 patients (4.1%). The indications were 1) abnormal liver function test: high level of alkaline phosphatase,

Table 3 Details of type of previous operation

Type of previous operation	Number of cases
Caesarian section	6
Explore laparotomy (long midline scar)	1
Total abdominal hysterectomy (TAH)	3
Appendectomy	2
Right nephrolithotomy	2
Open herniorrhaphy	1

Table 4 Detailed findings in difficult LC cases

Findings in difficult cases	Number of cases
Macronodular surface of livers	9
Adhesion at subhepatic space	10
Thick wall gall bladders	10
Enlarged cystic ducts (\varnothing 0.5-0.8 cm.)	3
Bi-cystic ducts	3
Impacted stone at gall bladder neck	1
Multiple bile ducts of gall bladder to liver (segment 4)	1
Posterior branch of cystic artery	5

Table 5 Summary of complications

Complications	Number of cases
Bleeding from (gall bladder bed)liver	4
Bleeding from cystic artery	1
2 nd postoperative day fever	4
Acute urinary retention	2
Intraabdominal collection (bile leakage)	1

2) history of gallstone pancreatitis, and 3) history of CBD stone. There was one patient with questionable filling defect at distal CBD and laparoscopic exploration of CBD was proceeded. The author could not find stone so T-tube was inserted in CBD laparoscopically. Jackson-Pratt drains were placed in 7 patients mostly due to bleeding from GB bed of macronodular liver surface, dissection both adhesion and thick wall GB.

The study found 12 patients with minor complications which mostly did not affect hospital stay. There were 5 patients (4.1%) with intra-operative bleeding but all cases could be controlled. Fever on the second postoperative day occurred in 4 patients (3.3%) without obvious causes. Intra-abdominal collection (bile leakage) took place in one patient (0.8%) who had to readmit. This patient was fully recovered by the conservative treatment. Two patients suffered from acute urinary retention which caused longer hospital stay (Table 5).

Ten patients were lost to follow-up. The average follow-up time was 22 months.

DISCUSSION

LC was converted to open procedure in 2 patients (1.6%). One patient had long midline surgical scar and there are a lot of intra-abdominal adhesions. The other was acute calculus cholecystitis which inflamed the gallbladder severely. In literatures conversion rate was 0.87% - 8.2%^{6,7} and the reasons of conversion were 1) intra-operative complications such as uncontrolled bleeding, 2) severe adhesion, and 3) anatomy distortion from inflammation.

The most common diagnosis in this study was gallstone without cholecystitis (78.8 %) and the next one was stones with chronic cholecystitis (8.3 %). The author's policy for the treatment of acute cholecystitis commenced with conservative management and followed with the elective LC in at least 2 months later.

Unfortunately, the pathological result of one patient showed cancer but further hepatectomy was not performed.

The mean operative time in literatures was about 76.8 minutes⁶ whereas it was 61.29 minutes in this study. The operative time may be influenced by two aspects. The first one was the difficult anatomy which each group of patients had with individual operation time (Table 6).

These groups of anatomy affected the operation time much longer than the average and caused complications as well. In the enlarged cystic duct group there have been many reports⁸⁻¹¹ suggesting how to manage them such as the preformed Endoloop, Endo GIA, multiple clip appliers and transfixing suture. In this study there was no problem at all to ligate the enlarged cystic duct. The mean operative time in the thick wall GB group was 95.3 minutes. This group of patients may also have adhesion. Patients who had inflammation of GB both acute/subacute or chronic would have varieties of morbidity. The author referred to begin with the medical treatment and the elective LC was performed approximately 2 months later. A report¹² suggested the appropriate time to perform surgery for cholecystitis patients should be during the same admission of acute attack. There were 9 patients (7.4%) with anatomical variation of cystic duct and artery. Therefore the troublesome bleeding or bile leakage might take place anytime during dissection of the Calot's triangle and GB bed.

The second aspect that prolonged operative time was complications. In this study there were 12 patients (10%) with complications. The most common complications (4.1%) were intra-operative bleeding which were controllable. There was no major bile duct injury. In literatures^{6,13} bile duct injury was found in

Table 6 Detailed anatomy of difficult cases and operative time

Anatomy	No.	Av. Op. time
Macronodular surface of livers	9	65
Adhesion at subhepatic space	10	88.5
Thick wall gall bladders	10	95.3
Enlarged cystic ducts (Ø 0.5-0.8 cm.)	3	123
Bi-cystic ducts	3	86.7
Impacted stone at gall bladder neck	1	80
Multiple bile ducts of gall bladder to liver	1	100

0.32- 4%. Belkhodja C. et al¹⁴ reported mechanisms of this injury were 1) excessive use of cautery around the Calot's triangle, 2) classical confusion between cystic duct and CBD, and 3) partial ligation of CBD by a clip on cystic duct. Bile leakage (intra-abdominal collection) arose in one patient and needed readmission at the 6th postoperative day with abdominal pain and fever. This patient had full recovery with conservative treatment. Many reports^{6,13,15} presented the bile leakage of 2.7-3.8%. The mean time from LC to symptom of abdominal pain and N/V was 4 days that caused the patient to hospital. The important step to avoid this complication should be meticulous dissection along Calot's triangle and GB bed due to high incidence of anatomical variation. The author summarized the preferred techniques to reduce complications as follows: 1) keep standard 4 port technique (3 of 5 mm. and 1 of 10 mm.), 2) begin with dissection of posterior peritoneum of the Calot's triangle, 3) create two windows over the Calot's triangle, 4) use intracorporeal knotting, and 5) meticulously dissect to look for the anatomical variation.

This study could follow up 111 patients with average time of 22 months. Muehlenberg¹⁶ reported a patient who had clip migration into CBD and consecutive calculus formation in 2 years after LC. Regarding expenses this study did not have enough data to compare between clip group and knot group. Normally 6 clips (300 baht each) were needed to apply each patient whereas 5.12 knots (70 baht each pack of silk) were employed in knot group. Clearly in the group of intracorporeal knotting the operation expenses should be much lower than the clip group.

CONCLUSION

LC with intracorporeal ligation of cystic duct was very safe and economical. This study never found cystic duct ligation failure or major bile duct injury and could manage all kinds of difficult cystic duct stump. The author advised 5 steps to avoid complications. Using this technique a surgeon should have sufficient experience to do intracorporeal knot by practicing in endo-box first.

REFERENCES

1. Golash V. An experience with 1000 consecutive cystic duct ligation in laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech* 2008; 8:155-6.
2. Hanazaki K, Igarashi J, Sodeyama H, Matsuda Y. Bile leakage resulting from clip displacement of the cystic duct stump: a potential pitfall of laparoscopic cholecystectomy. *Surg Endosc* 1999;13:168-71.
3. Saha SK. Ligating the cystic duct in laparoscopic cholecystectomy. *Am J Surg* 2000;179:494-6.
4. Lim BS. Intracorporeal ligation of the cystic duct during laparoscopic cholecystectomy. *Surg Laparosc Endosc* 1996;6:388-91.
5. Kitano S, Moriyama M, Sugimachi K. A simple and rapid technique for suture ligation during laparoscopic cholecystectomy. *Surg Laparosc Endosc* 1992;2:321-2.
6. Huscher CG, Lirici MM, Dipaola M, Crafa F, Napolitano C, Mereu A, et al. Laparoscopic cholecystectomy by ultrasonic dissection without cystic duct and artery ligation. *Surg Endosc* 2003;17:442-51.
7. Lohde E, Gemperle A, Kraas E. Ligation of the cystic duct - experience in 1750 laparoscopic cholecystectomies. *Chirurg* 1993;64:789-3.
8. Abbas IS. Overlapped-clipping, a new technique for ligation of a wide cystic duct in laparoscopic cholecystectomy. *Hepatogastroenterology* 2005;52:1039-41.
9. Yeh CN, Jan YY, Liu NJ, Yeh TS, Chen MF. Endo-GIA for ligation of dilated cystic duct during laparoscopic cholecystectomy: an alternative, novel, and easy method. *J Laparoendosc Adv Surg Tech A* 2004;14:153-7.
10. Nowzaradan Y, Meador J, Westmoreland J. Laparoscopic management of enlarged cystic duct. *Surg Laparosc Endosc* 1992;2:323-6.
11. Ota A, Kano N, Kusanagi H, Yamada S, Garg A. Techniques for difficult cases of laparoscopic cholecystectomy. *J Hepatobiliary Pancreast Surg* 2003;10:172-5.
12. Lee AY, Carter JJ, Hochberg MS, Stone AM, Cohen SL, Pachter HL. The timing of surgery for cholecystitis: a review of 202 consecutive patients at a large municipal hospital. *Am J Surg* 2008;195:467-70.
13. Seenu V, Shridhar D, Bal C, Parshad R, Kumar A. Laparoscopic cholecystectomy: cystic duct occlusion with titanium clips or ligature? A prospective randomized study. *Trop Gastroenterol* 2004;25:180-3.
14. Belkhodja C, Porte H, Quandalle P. Pedicular traumas during laparoscopic cholecystectomy. A propos of 5 cases. *Ann Chir* 1995;49:149-54.
15. Woods MS, Shellito JL, Santoscoy GS, Jagan RC, Kilgore WR, Traverso LW, et al. Cystic duct leaks in laparoscopic cholecystectomy. *Am J Surg* 1994;168:560-3.
16. Muehlenberg K, Loffler A. Clip migration in the common bile duct and consecutive calculus formation after laparoscopic cholecystectomy. *Z Gastroenterol* 1995;33:108-11.