

# New-Style Laparoscope and Endoscope Cooperative Gallbladder-Preserving Surgery for Polyps

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## ABSTRACT

**Objective:** To evaluate the feasibility and safety of a new style of Laparoscope and Endoscope Cooperative gallbladder-preserving Surgery (LECS), an improved method of minimally invasive gallbladder-preserving polypectomy.

**Study Design:** An experimental study.

**Place and Duration of Study:** Department of General Surgery, The Second Affiliated Hospital of Soochow University, China, from January 2009 to July 2013.

**Methodology:** Clinical data of patients subjected to LECS and Laparoscopic Cholecystectomy (LC) was analysed. The inclusion criteria were normal size clear gallbladder bile with total volume (FV) of the gallbladder = 15 - 25 ml, the Residual Volume (RV) = 5 ml, and the Emptying Figure (EF) > 75%, with polyps diagnosed definitively by B-type ultrasonic imaging or CT desirous of preserving gallbladder. Exclusion criteria were a history of midsection surgery, serious diseases of any organ, hepatic injury, or coagulation disturbance. Mean hospital stay and complications were also noted. Independent sample t-test, the frequency comparison used chi-square test ( $N > 5$ ), and Fisher's exact test ( $N < 5$ ) were used for statistical test.

**Results:** The mean hospital stay after LECS was  $3.50 \pm 0.31$  days, and  $3.50 \pm 0.31$  days for the LC group. The mean age in LC and LECS group was  $50 \pm 25.4$  and  $44 \pm 12.1$  years, respectively. Complications after operation in the LECS were indigestion and diarrhea; LC group had indigestion (9.33%), diarrhea (10.67%), and gastroesophageal reflux (6.6.7%). In the 3 months follow-up after discharging from the hospital, no patient had recurrence of any gallbladder disease; at 1 year follow-up, 1 patient (1.28%) developed cholesterol crystals; at 3-year follow-up, 3 cases (3.84%) were found to have recurring polyps (2~4 pieces), and 2 (2.56%) patients developed cholesterol crystals.

**Conclusion:** Minimally invasive gallbladder-preserving polypectomy which used a CHIAO cholecystoscopy compared with a laparoscope is safe, feasible, and can effectively reduce the vestiges and recrudescence of polyps in gallbladder-preserving surgery.

**Key Words:** *Laparoscope and endoscope cooperative surgery (LECS). CHIAO cholecystoscope. Gallbladder-preserving surgery. Gallbladder polyps.*

## INTRODUCTION

Functional gallbladders should not be on the list of removed organs. With the advance of modern medicine, clinical results have demonstrated that the gallbladder has complex and extremely important functions, and cholecystectomy often lead to various complications in patients. In investigations regarding patients after cholecystectomy (CHE), an increased DGR was shown with scintigraphy,<sup>1-3</sup> aspiration and analysis of gastric contents,<sup>4,5</sup> 24-hour pH monitoring and the Billitec device.<sup>6-9</sup> Good results have been obtained since the new style of laparoscope and endoscope cooperative surgery for gallbladder-preserving polypectomy, with the combination of laparoscope and CHIAO cholecystoscopy, was first performed in our hospital in April 2009.<sup>10</sup>

Minimally invasive surgery for the removal of polyps and preservation of gallbladder with the combination of laparoscope and CHIAO cholecystoscopy has been highly successful since then.

The objective of this study was to evaluate the feasibility and safety of laparoscope and endoscope cooperative gallbladder-preserving surgery (LECS), an improved method of minimally invasive gallbladder-preserving polypectomy.

## METHODOLOGY

This study was carried out in Department of General Surgery, The Second Affiliated Hospital of Soochow University, China, from January 2009 to July 2013. It is a retrospective analysis and comparative experimental study of laparoscope and endoscope cooperative gallbladder-preserving surgery (LECS).

In the LECS group, 78 cases were chosen suited to the standards that: (1) The ultrasound echoes of gallbladder bile were clear, the total volume (FV) of the gallbladder was 15 - 25 ml, the Residual Volume (RV) was 5 ml, and the Emptying Figure (EF) > 75%. (2) The size and shape of the gallbladder suit wall was < 5 mm with 7 x 4 cm

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size. Polyps were diagnosed definitively by B-type ultrasonic imaging or CT. (3) They had a strong desire of preserving gallbladder.

No history of midsection surgery, serious diseases of any organ, hepatic injury, or coagulation disturbance, were exclusion criteria.

In the LC group, 75 patients were stochastically chosen without other organic or chronic disease who underwent LC from 2009 to 2013 from the anamnesis system.

The operation equipment included a laparoscope operation camera system and a mini-laparoscope, CHIAO cholecystoscope and its accessories.

Endotracheal intubation was performed with the patients at a supine position under intravenous balanced general anesthesia in all cases. The initial incision was made 0.6 cm revolved around the navel in the right or 0.6 cm straight directly over the navel. Pneumoperitoneum was caused by penetration of an aeroperitonia needle. Then a trocar was implanted, then a mini-laparoscope was used to observe the position of the gallbladder and examine the gallbladder and extrahepatic biliary tract as well as the gallbladder bed. A 1.5 - 2.0 cm incision was made under the right rib edge on the right midclavicular line near the fundus of the gallbladder, and a 10 mm trocar was implanted. The fundus of the gallbladder was pulled outside the abdominal wall with laparoscope forceps (Figure A), and a 1.0 cm segment was cut off (Figure B). After bile was suctioned, the gallbladder was explored with a CHIAO cholecystoscope (diameter 6.4 mm) under low pressure (put the water in the height of 2 meters from the ground and let the water flow down just to the gravity) water injection (Figure C). Electrocoagulation was used to block vessel at the base or the pedicle of the polyps, and the polyps were

removed and bleeding was further stopped (Figure D). Then 3 - 0 absorbable surgical suture was used for closing the incision on the gallbladder with continuous suture technique and then full thickness direct suture closure to reinforce the incision (Figure E). Obese patients, whose BMI  $\geq 30$  as the Asian Standard stipulated, were not subjected to the right rib edge incision; instead, removal of polyps and preservation of the gallbladder were performed by using a CHIAO cholecystoscope under the laparoscope for those patients. The removed polyps were snap-frozen and sectioned for testing; and if found cancerous, the patient was immediately treated by gallbladder carcinoma radical resection under open surgery. Patients found to have too many polyps covering the gallbladder mucosa, or severe adhesion to gallbladder surrounding tissues, or difficulty to stop bleeding, were subjected to Laparoscope Cholecystectomy (LC).

A modified VRS-5 (verbal rating scales-5) system was used for the assessment of pain level: 1=no pain, 2=mild pain, 3=moderate pain, 4=severe pain, 5=intolerable pain. All patients were requested to give an answer at postoperative 24-hour and 1-week follow-up time.

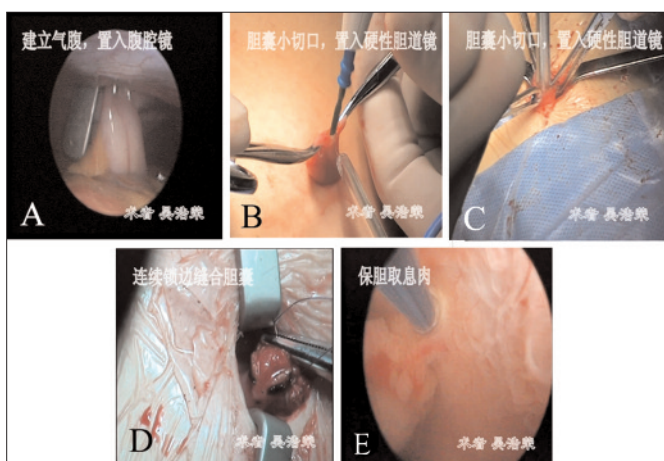
Statistical software SPSS version 19 and Graph Pad Prism 5 was used for statistical analysis of data expressed as a standard deviation of the mean  $\pm$ SD value. Two groups of data comparison used independent sample t-test, and the frequency comparison used chi-square test ( $N > 5$ ) and Fisher's exact test ( $N < 5$ ) showed no statistically significant difference.

### RESULTS

Table I describes demography and polyp number analysis, different types and groupings of gallbladder polypectomy were recorded and took into statistical analysis separately. Mean age in LC and LECS group was  $50 \pm 25.4$  and  $44 \pm 12.1$  years, respectively ( $p=0.0629$ ); whereas there were no significantly difference in gender between the two groups ( $p=0.9531$ ). Comparison between polyp number proportionality in two groups showed a p-value of 0.0101 which means that multiple-polyp suits more to LC. This data showed that the patients in the two groups had no significant difference in age and gender.

LECS group required more operating time than LC group (Table II). Mean hospital stay after operation and polyp recurrence showed no statistically significant difference. Proportion of various pain scores at postoperative 24-hour and 1-week postoperatively contrasted little between two groups. Table III states complications after polypectomy.

Of the 78 patients in LECS group, polyps were successfully removed by CHIAO cholecystoscope with the gallbladder preserved in 70 cases. Four obese patients were successfully operated with CHIAO



**Figure 1:** (A) The fundus of the gallbladder was pulled outside the abdominal wall with laparoscope forceps. (B) A 1.0 cm segment was cut off. (C) The gallbladder was explored with a CHIAO cholecystoscope under low pressure water injection. (D) Electrocoagulation was used to block vessel at the base or the pedicle of the polyp and the polyps were removed with laparoscope forceps. (E) Use 3-0 absorbable surgical suture to close the incision on the gallbladder in continuous suture technique and then full thickness direct suture closure to reinforce the incision.

**Table I:** Comparison of demography of the two groups.

	Group I	Group II	p-value
Age (years)	50 ±25.4	44 ±12.1	0.0625
Patient number	75	78	-
Surgery method	LC	LECS	-
Gender (female/male)	56/19 (74.67%/25.33%)	52/26 (66.67%/33.33%)	0.2776
Polyp number (one polyp/multiple polyp)	52/23 (69.33%/30.67%)	68/10 (87.18%/12.82%)	0.0101

**Table II:** Perioperative and morbidity parameters.

	LC N=75	LECS N=78	p-value
Operating time (min)	49 ±9.4	58.0 ±8.1	<0.0001**
Hospital stay after operation	3.46 ±0.35	3.50 ±0.31	0.4550
Pain score at postoperative 24 hours			
1	3 (4%)	4 (5.13%)	1.0000
2	70 (93.33%)	72 (92.31%)	0.8061
3	2 (2.67%)	2 (2.56%)	1.0000
4	0	0	-
5	0	0	-
Pain score at postoperative 1 week			
1	68 (90.67%)	72 (92.31%)	0.7159
2	6 (8%)	5 (6.41%)	0.7035
3	1 (1.33%)	1 (1.28%)	1.0000
4	0	0	-
5	0	0	-
Incision infection	0	2 (2.56%)	0.4969
Polyp recurrence	0 (0%)	3 (3.85%)	0.2454

NS = No significant difference. Pain score: 1 = no pain, 2 = mild pain, 3 = moderate pain, 4 = severe pain, 5 = intolerable pain. 2 cases are subumbilical incision infection. \*p-value <0.05

**Table III:** Complications after polypectomy among the groups.

	LC (N=75)	LECS (N=78)	p-value
Indigestion	7 (9.33%)	1 (1.28%)	0.0316*
Abdominal distension	6 (8%)	2 (2.56%)	0.1614
Diarrhea	8 (10.67%)	1 (1.28%)	0.0163*
Duodenogastric reflux	3 (4.00%)	0 (0%)	0.1154
Gastroesophageal reflux	5 (6.67%)	0 (0%)	0.0264*
Cholelithiasis	2 (2.67%)	0 (0%)	0.2386
Infection of the incisional wound	0 (0%)	1 (1.28%)	1.0000

\*p-value <0.05; \*\*p-value <0.01; \*\*\*p-value <0.001

cholecystoscope under laparoscope. In 2 cases, too many polyps were found covering the gallbladder mucosa and Laparoscope Cholecystectomy (LC) was performed. Two cases were treated by gallbladder carcinoma radical resection based on rapid pathological diagnosis of gallbladder carcinoma after polyps were successfully removed by hard gallbladder endoscope. Two cases were converted to cholecystectomy because of gallbladder atrophy, severe adhesion to surrounding tissues, and difficulty in stopping mucosa bleeding.

The pathology histology of the resected polyps, 63 cases (80.76%), were cholesterol polyps, 5 cases (6.41%) were adenomatoid polyps, and 8 cases (10.26%) were inflammatory polyps. Two cases (2.56%) were adenomatoid polyp which were changed to the radical resection.

The median length of hospitalization was 3.50 ±0.31 days after operation. There was no complication of bile leakage or digestive bleeding. In the 3 months follow-up after discharging from the hospital, no patient had any recurrent gallbladder disease; 1 year follow-up, 1 patient (1.28%) developed cholesterol crystal; 3 years follow-up, 3 cases (3.84%), were found to have recurring polyps (2~4 pieces), and 2 patients (2.56%) developed cholesterol crystal.

## DISCUSSION

Gallbladder serves to store, concentrate and excrete bile. Recent studies also suggest certain immune functions. With the recognition of the importance of gallbladder function and the harmful effects on the human body after cholecystectomy, more and more experts sanction conserving gallbladder function.<sup>11</sup> Cholecystectomy has been considered a primary treatment of gallbladder polyps, but traditional cholecystectomy would affect the quality of life and even threaten the life of patients. Complications of cholecystectomy include indigestion, abdominal distension and diarrhea, Duodenogastric Reflux (DGR), gastroesophageal reflux, Postcholecystectomy Syndrome (PCS) and high incidence of choledocholithiasis.<sup>12</sup> Using a laparoscope combined with a choledochoscope for removal of the calculus and preservation of the gallbladder, not only fully reflects the characteristics of minimally invasive technology but also greatly reduces the rate of residual stones by watching the true face of the mucosa of the gallbladder lumen directly with an endoscope and taking the calculus and polyp completely.<sup>13,14</sup> In addition, there is an increasing rate of developing colon cancer in patients after cholecystectomy compared with patients not treated by cholecystectomy.<sup>15</sup> With the increased demand for higher quality of living and the widespread use of laparoscope and choledochoscope in minimally invasive surgery, more and more patients request to preserve their gallbladders.

There is a lack of official definition of the indication and contra-indication of the laparoscope and endoscope cooperative gallbladder-preserving surgery for gallbladder polyp. Several indications are generally accepted in China. Normal function of gallbladder is a prerequisite. The functions of gallbladders can be readily assessed by ultrasonic examination including: the ultrasound echoes of gallbladder bile should be clear, the total volume (FV) of the gallbladder should be 15 - 25 ml, the Residual Volume (RV) should be 5 ml,



and the Emptying Figure (EF) > 75%.<sup>16,17</sup> The size and shape of the gallbladder should be normal, with the wall < 5 mm and 7 cm x 4 cm in size. Polyps must be diagnosed definitively by B-type ultrasonic imaging or CT. The patient should have a strong desire of preserving gallbladder. He should not have a history of midsection surgery, serious diseases of any organs, hepatic injury, or coagulation disturbance.<sup>18</sup> The size of polyp is not a limitation of indication, but the results of frozen section of removed polyps could affect the decision whether to preserve gallbladder or not. One can also perform the gallbladder sparing operation if the pathological diagnosis of the polyps (with the size > 10 mm) is benign. The contra-indications include marked thickening of the gallbladder wall (> 7 mm) or the interoperation of the pathological specimen of the polyp is malignant tumor or adenomatous hyperplasia.<sup>18</sup> Patients with malignant polyps should not be treated by gallbladder-preserving surgery but by traditional cholecystectomy. The base of the polyp is too wide to be removed completely. Therefore, the success of gallbladder preservation depends on the pre-operation results of type-B ultrasonic imaging and MRCP, combined with operative exploration by laparoscope and hard endoscope. In this study group, a total of 4 cases were converted to LC due to excessive number of polyps, gallbladder atrophy, severe adhesion to surrounding tissues, or difficulty in controlling mucosa bleeding.

The CHIAO cholecystoscope can provide the view of a full picture of the gallbladder, separate the adhesion from surrounding tissues, and avoid injury of surrounding tissues.<sup>10</sup> It can also magnify the images to 8 - 10 times to make close observation of the mucosa feasible. The image is stable and clear, allowing discovery of microfoci.<sup>19</sup> A characteristic of the soft choledochoscope is the good activity performance of its extremity, it could observe every corner of the inner wall of the gallbladder, and it is beneficial to adjust different angles so that calculi can be taken from different positions.<sup>20</sup> It could smoothly enter the gallbladder tube and directly observe the entrance of the gallbladder tube to the common bile duct. The soft choledochoscope has the advantage in judging whether there has been bile circumfluence and helping to take out the calculi embedded in the gallbladder tube or the gallbladder neck, if there are calculi in the gallbladder duct.<sup>21</sup> The attached biopsy forceps and coagulation bars are particularly advantageous in facilitating the discovery and removal of polyps. During the operations, coagulation bars were applied to coagulate the blood vessels of the roots of gallbladders under CHIAO cholecystoscope, and removed the polyps from the roots by biopsy forceps.<sup>22</sup> The power of the coagulation bars should be set at 5W, and the coagulation time is 1-2s. It is important to perfect the control of coagulation bars,

because lower power would not give desired hemostatic effects, and higher power could easily cause perforation of the gallbladder. When using coagulation bars during the operation, 5% glucose should be injected to flush the gallbladder cavity without the electrolyte solutions, in order to maximize coagulation effects and avoid damage to other sites of mucosa. When removing small polyps, grasp tongs or biopsy forceps should be used to avoid washing the small polyps away. As for the polyps with wide basements, the polyps should be completely removed without leaving residual polyps behind, and care should be taken not to damage the gallbladder. In some cases, as for 2 patients in this study, the polyps are too numerous to be safely removed by endoscopy, in which case LC should be performed instead. Flawless surgical instruments are necessary for the success of the operation. The coagulation bars play important roles during removing polyps and stopping bleeding. If the biopsy forceps are equipped with coagulation functions, it will significantly improve the ease of the operation.

The main limitation of the data is its retrospective nature. However, the follow-up was sufficiently long to offset this disadvantage.

## CONCLUSION

The combination of CHIAO cholecystoscope and laparoscope would be helpful to maximize favorable factors and minimize unfavorable ones for the removal of polyp and preservation of the gallbladder, increase the rate of removing polyp completely, shorten hospital stay by decreasing complications after operation, and increase the rate of preserving the gallbladder.

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