Three-port versus conventional four-port laparoscopic cholecystectomy: a comparative study

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Objectives
This prospective comparative study aims at evaluating the feasibility of three-port technique without affecting safety and at comparing the outcome of three-port and four-port techniques.
Patients and methods
This study included 94 patients with symptomatic gallstone disease and gallbladder polyp in Surgical Department, Minia University Hospital, from beginning of 2018 to beginning of 2019. Patients who were unwilling to be a part of the study, jaundiced patients with radiologically evidence of common bile duct stones, patients unfit for general anesthesia, patients with liver cirrhosis, patients with portal hypertension, patients with coagulopathy, patients with acute pancreatitis, patients with generalized peritonitis, or patients with malignancy were excluded. All patients were operated by the same operating team. Patients were randomized for three-port laparoscopic cholecystectomy (LC) group (45 patients) or four-port LC group (49 patients). Numeric Pain Rating Scale, operative time, operative difficulty, intraoperative and postoperative complications, duration required to stop oral analgesics, and duration required to return to normal activity were recorded.
Results
Numeric Pain Rating Scale, required number of diclofenac ampoules, duration required for oral analgesia, and duration required to return to normal activity were significantly less in three-port group. Other parameters were comparable between the two groups.
Conclusion
It seems that three-port LC is a safe and feasible technique with superior clinical outcomes to four-port LC.

Keywords:
four port, laparoscopic cholecystectomy, outcome, three port

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Introduction

Phillip Mouret performed the first laparoscopic cholecystectomy (LC) in 1987, and later, Dubois and Perissat established it in 1990 [1]. Among digestive tract disorders, diseases of the gallbladder constitute the most, of which gallstone disease is the most common [2]. The mainstay of treatment for symptomatic gallstone disease is cholecystectomy. LC is the most accepted method of treatment of cholelithiasis since National Institute of Health Consensus Development Conference in September 1992 and is considered now as the 'gold standard' for treatment of gallstones [3,4]. Attempts at improvement since the first LC are continuous aiming at improving cosmesis and reduction of postoperative pain, hospital stay, and cost [5]. Reduction of pain and duration of hospital stay postoperatively has been attempted through reduction in the size and number of ports [6–8]. Reducing the number of the ports from four to three is the most practical option [9]. In American technique, the gallbladder fundus is grasped and retracted laterally through the lateral fourth port to expose the Calot's triangle. In the three-port technique, the use of this fourth port was omitted with encouraging results from recent studies [6,10]. Performing LC without much difficulty by using the three-port technique defines technical feasibility. This three-port technique is considered to be failed if a fourth port is needed [11]. This prospective comparative study aims at evaluating the feasibility of the three-port technique without affecting the safety and at comparing the outcome of the three-port and four-port techniques regarding operative time, complications, postoperative pain, hospital stay, cosmetic outcome, and return to work.

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Patients and methods

This study included 94 patients with symptomatic gallstone disease and gallbladder polyp confirmed by ultrasound in the Surgical Department, Minia University Hospital, from the beginning of 2018 to the beginning of 2019. The study was approved by Ethical Committee of Minia College of Medicine. Patients who were unwilling to be a part of the study, jaundiced patients with radiologically evidence of common bile duct stones, patients unfit for general anesthesia, patients with liver cirrhosis, patients with portal hypertension, patients with coagulopathy, patients with acute pancreatitis, patients with generalized peritonitis, or patients with malignancy were excluded. All patients were operated by the same operating team. Informed consent for randomization had been taken from all patients. Patients were randomized for the three-port LC group or the four-port LC group. The patients' demographics and ultrasound findings were recorded. Preoperative workup was done, and patients were admitted the day before surgery.

Three-port technique

The pneumoperitoneum was achieved by either open Hasson's technique or Veress needle technique. Ten-millimeters infraumbilical (camera port), 10-mm subxyphoid (working port), and single 5-mm right midclavicular subcostal ports were inserted. We used a 10-mm 30° operating telescope (Karl Storz, Germany) in the infraumbilical port. The gallbladder was retracted using grasping forceps through the 5-mm port holding the infundibulum by it jaws and retracting the liver by its shaft providing exposure similar to that done by fundal grasper. Dissection was done through the 10-mm subxyphoid port. The infundibulum was retracted with the left hand, and anterior and posterior dissection is done in Calot's triangle with the right hand creating wide window. Additional fourth port was inserted in two cases of the three-port group, owing to distended Hartman's pouch obscuring the Calot's triangle in one case and long gallbladders with long peritoneal fold that fell repeatedly on the dissection area in Calot's triangle in the other case. Critical view of safety was obtained as it is the most important step to avoid bile duct injury. Clipping of the cystic duct and cystic artery was achieved using 10-mm reloaded single clip applicator through the 10-mm subxyphoid port. Retrieval of the gallbladder was done through either the subxyphoid or the umbilical port. Irrigation was done, and a suction drain no. 14/16 was placed subhepatic through the 5-mm port. Skin incisions were closed by 2–0 proline and infiltrated with 0.5% lidocaine in all patients. Surgical adhesive tape was applied to the port sites at the end of the operation. All dressings were kept in place until the first follow-up visit after 1 week.

Four-port technique

Another 5-mm port was inserted in right flank in the anterior axillary line in addition to the three ports used to grasp and provide traction to the gallbladder fundus. Rest of the procedure was the same as the three-port technique.

Diclofenac 50 mg was given intramuscularly every 8 h during the first postoperative 24 h for pain control. Pain score was the primary outcome measured by Numeric Pain Rating Scale (NPRS). All patients made three pain ratings (current, best, and worst pain) from 0 to 10 (0; no pain and 10; worst pain imaginable) over the first postoperative 24 h. Patient's level of pain was represented by the average of the three ratings [12]. Other outcome measures included operative time and operative difficulty. The operative time was calculated from the first incision until finishing wound closure. Patients were discharged the day of surgery or the next postoperative day if pain is controlled, oral intake can be tolerated, and no other problems arose; otherwise, the discharge was delayed. The duration required to stop oral analgesic tablets and duration required to return to normal activity were recorded.

Statistical analysis

For categorical parameters, Pearson χ^2 test was applied. Mann–Whitney U test was applied for continuous variables and analysis of NPRS. A P value of less than 0.05 was considered statistically significant. Data were generated with SPSS software (version 18, SPSS Inc., Tuttlingen, Germany).

Results

The study included 94 patients: three-port group included 45 (47.9%) patients and four-port group included 49 (52.1%) patients. Patients' characteristics are shown in Table 1. In the three-port group, additional port was added in two (4.4%) patients whereas one (2.2%) patient was converted to open cholecystectomy. In the four-port group, two (4.1%) patients were converted to open cholecystectomy (Table 2). There was no statistically significant difference between the two groups (P=0.29). Regarding intraoperative complications (bleeding, adhesions, spillage, biliary injury, and visceral injury), the difference was not statistically significant between the two groups (P=0.81) (Table 3). The amount of

Table 1 Patient characteristics

	Three-port group	Four-port group	*P* value
Age (years, mean±SD)	38.26±13.6	37.65±11.69	0.92
Sex [*n* (%)]			
Male	9 (20)	5 (10.2)	0.25
Female	36 (80)	44 (89.8)	
Weight (kg, mean±SD)	76.11±12.7	77.37±10.9	0.3
Ultrasound [*n* (%)]			
Calculi	44 (97.8)	48 (98)	0.95
Polyp	1 (2.2)	1 (2)	
Acute symptoms [*n* (%)]	1 (2.2)	2 (4.1)	0.61
Chronic symptoms [*n* (%)]	44 (97.8)	47 (95.9)	

Table 2 Conversion

	Three-port group [*n* (%)]	Four-port group [*n* (%)]	*P* value
Conversion to open	1 (2.2)	2 (4.1)	0.29
Conversion to 4-port technique	2 (4.4)	–	
No conversion	42 (93.4)	47 (95.9)	

Table 3 Intraoperative complications

	Three-port group [*n* (%)]	Four-port group [*n* (%)]	*P* value
Bleeding	1 (2.2)	1 (2)	0.81
Adhesions	13 (28.9)	11 (22.4)	
Bile spillage	6 (13.3)	5 (10.2)	
None	25 (55.6)	32 (65.3)	

Table 4 Procedure outcomes

	Three-port group (mean ±SD)	Four-port group (mean ±SD)	*P* value
Operative time (min)	43.3±18.6	40.2±20.1	0.07
Diclofenac injection (number of ampoules)	3.25±0.9	4.12±0.54	0.004
Duration of oral analgesia (days)	3.5±0.55	4.6±0.92	0.02
Postoperative hospital stay (days)	1.17±0.13	1.32±0.21	0.41
Duration required to return to normal activity (days)	4.9±0.92	5.7±1.75	0.02
NPRS (0–10)	2.03±0.91	2.87±1.14	0.03

NPRS, Numeric Pain Rating Scale.

Table 5 Postoperative complications

	Three-port group [*n* (%)]	Four-port group [*n* (%)]	*P* value
Wound infection	1 (2.2)	1 (2)	0.88
Wound hematoma	1 (2.2)	2 (4.1)	
None	43 (95.6)	46 (93.9)	

Table 6 Cosmetic satisfaction

	Three-port group [*n* (%)]	Four-port group [*n* (%)]	*P* value
Good	37 (82.2)	33 (67.3)	0.23
Fair	7 (15.6)	15 (30.6)	
Bad	1 (2.2)	1 (2)	

intraoperative blood loss was less than 10 ml in most patients in both groups. The adhesions in Calot's triangle were encountered in 13 (28.9%) patients in three-port group and in 11 (22.4%) patients in four-port group. Bile spillage was seen in six (13.3%) patients in the three-port group and five (10.2%) patients in the four-port group. Drain was placed in one (2.2%) patient in the three-port group and in two (4.1%) patients in the four-port group and removed on the first postoperative day. Biliary and visceral injury did not occur in any patient in both groups. Regarding operative time, the three-port group had a statistically insignificant slightly longer mean operative time than the four-port group (P=0.07). NPRS was assessed in the postoperative period, and the average of the three rating was found to be significantly less in the three-port group (P=0.03). Number of diclofenac ampoules required in the first postoperative day was significantly less in the three-port group (P=0.004). Moreover, duration required for oral analgesia was significantly shorter in the three-port group (P=0.02). Postoperative hospital stay was insignificantly less in the three-port group (P=0.41). However, the duration required to return to normal activity was significantly less in the three-port group (P=0.02) (Table 4). Regarding postoperative complications, the difference between the two groups was not statistically significant (P=0.88). Wound infection occurred in one patient in each group, wound hematoma in one (2.2%) patient in the three-port group, and in two (4.1%) patients in the four-port group, but port-site hernia did not occur in any patient over 1 month of follow-up (Table 5). Satisfaction about cosmetic results between the two groups was statistically insignificant (P=0.23) (Table 6).

Discussion

The treatment of choice for gallstone disease is LC [3,4]. American technique uses the fourth right flank port to retract the gallbladder fundus, whereas French technique uses the fourth right flank port to retract the liver to expose Calot's triangle [10,13]. Improving outcome of LC depends on reduction in postoperative pain, better cosmetic results, and early return to work. It has been claimed that reduction in the number and size of ports can achieve this outcome

[11]. This was proved by previous studies [14,15]. In the present study, port reduction to three has shown positive results without affecting safety. The present study included 94 patients, with most of the patients being females (85.1%). The mean age was 37.95±12.6 (range, 18–80 years old) years. Male to female ratio was 1 : 5.7. Gallstone disease is predominant in middle aged females, which might be linked to estrogen hormone [16]. Most of the patients in both groups had gallstones (92 patients, 97.9%) with chronic symptoms (91 patients, 96.8%). During the procedure, nasogastric tube was inserted to deflate the stomach hence facilitating better visualization and removed at the end of the procedure [17,18]. Intraoperatively, adhesions were encountered in 28.9% patients in the three-port group and 22.4% patients in the four port, mostly near the Calot's triangle separated using monopolar diathermy or irrigation and suction device. In the three-port group, there were two conversions to four-port technique and one conversion to open cholecystectomy. The forth port was inserted owing to distended Hartman's pouch obscuring the Calot's triangle in one case and long gallbladders with long peritoneal fold that fell repeatedly on the dissection area in Calot's triangle in the other case. The cause of conversion to open cholecystectomy in one case was bleeding from the cystic artery which could not be controlled laparoscopically. In the four-port group, there were conversions of two cases to open cholecystectomy owing to dense adhesions between the gallbladder and the surrounding structures. Other causes of conversion such as cholecystoduodenal fistula, intrahepatic adhesions, and failure of equipment were reported in previous studies [19–21]. We found that the difference between the two groups regarding intraoperative complications was not statistically significant. The mean operative time was insignificantly shorter for the four-port group, which agreed with the previous studies [6,8,22]. This might be owing to that the fourth port addition provides good exposure facilitating dissection at the Calot's triangle owing to lateral retraction of the gallbladder. On the contrary, some authors reported shorter operative time with the three-port procedure, and their explanation depends on the time lost during establishment and closure of the forth port [6,11,23,24]. As the three-port LC is a relatively new technique, we believe that with increasing experience, the operative time will be less. Postoperative outcomes were in favor of the three-port group. Postoperative pain, use of analgesics, and duration required to return to normal activity were significantly less in the three-port group. Mean hospital stay was insignificantly less in the three-port group. One month after surgery, patient satisfaction about cosmetic outcome was statistically insignificant between the two groups. Partial satisfaction of some patients may be owing to their preconception that the number of scars can be reduced. Although the operative time was slightly longer in the three-port LC, postoperative pain, time of discharge, and return to normal activity were in favor of the three-port LC. The three-port LC was associated with reduced cost of an additional port, less use of analgesics, and less work days lost, so it seems cost-effective than four-port LC. Complications which had occurred intraoperatively and conversion rates were comparable in both techniques. The three-port LC might be difficult in some situations such as thick wall of the gallbladder, gallbladder packed with calculi, impacted calculus at Hartman's pouch, gallbladder empyema, severe adhesions especially at Calot's triangle, and acute cholecystitis [11]. So, LC can be started with three ports and in case of facing such difficulties a forth port can be inserted.

Conclusion

It seems that the three port LC is a safe and feasible technique with superior clinical outcomes to the four-port LC, so it can be a good alternative to the four-port conventional LC. However, the study was limited by the small number of cases and single-institute experience, so further studies on a larger number of cases in multiple centers are recommended.

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Conflicts of interest

There are no conflicts of interest.

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