

Three Ports Placed in the Linea Alba of the Abdomen (Three-Midline-Ports Technique): An Alternative Approach for Laparoscopic Cholecystectomy

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Abstract

Introduction: Laparoscopic cholecystectomy is the commonest operation performed laparoscopically worldwide. In this study, we compared a three-midline-ports approach with the standard “French” method for laparoscopic cholecystectomy.

Patients and Methods: A prospective, randomized study was performed between March 2010 and January 2011. One hundred consecutive patients undergoing elective cholecystectomy for symptomatic gallstones were included. The patients were randomized into two groups: those patients undergoing laparoscopic cholecystectomy following the “French” technique with three ports (Group 1) and those ones undergoing the three-midline-ports approach (Group 2).

Results: Mean operation time was 70.1 ± 19.15 minutes in Group 1 versus 65.9 ± 17.03 minutes in Group 2 (not significant). Complications appeared in 1 patient (2%) in each group (not significant). There was no mortality. Median hospital stay was 1.5 days in both groups. Median postoperative pain evaluated by visual analog scale was 4 (range, 1–7) in Group 1 and 2.5 (range, 0–4) in Group 2 ($P = .002$). In both groups, the most painful port was the subumbilical one, followed by the 10-mm port and then the 5-mm one. The visual analog scale evaluation separately of the 10-mm port was 2.5 in Group 1 versus 1.5 in Group 2 ($P = 0.04$).

Conclusions: The three-midline-ports approach is a feasible technique, safe and easy to implement, associating lower postoperative pain than the standard “French” approach.

Introduction

LAPAROSCOPIC CHOLECYSTECTOMY is the gold standard treatment of symptomatic gallstones and is the commonest operation performed laparoscopically worldwide. The indications for its use in the treatment of gallstones are the same as for the open operation. However, the laparoscopic approach has reduced the magnitude of the intervention, decreasing the morbidity and mortality of cholecystectomy.^{1–5}

Two approaches of laparoscopic cholecystectomy are accepted as standard techniques: the “French” one and the “American” one. Both approaches differ only in the placement of the ports and in the position of the surgeon (between the legs of the patient in the “French” approach and on the left side in the “American” one). Both techniques obtain similar results in most studies, and the choice depends on the

surgeons’ habits.^{1–5} However, some authors have reported that the “French” method leads to less impairment of pulmonary function but is associated with more postoperative pain.⁶

In this study we want to evaluate prospectively the three-midline-ports approach for laparoscopic cholecystectomy, comparing it with the “French” method performed with three ports, in terms of safety, operation time, postoperative pain, and hospital stay.

Patients and Methods

A prospective, randomized study was performed at General University Hospital of Elche (Alicante, Spain) between March 2010 and January 2011. One hundred consecutive patients undergoing elective cholecystectomy for symptomatic gallstones were included.

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The patients were randomized into two groups: those patients undergoing laparoscopic cholecystectomy following the "French" technique with three ports (Group 1) and those ones undergoing the three-midline-ports approach (Group 2).

Those cases in which the insertion of a fourth port was necessary were excluded from the study.

Procedure of the three-midline-ports technique

The patient is operated in the supine position. The surgeon operates from the left side of the patient with the camera person by his side; the scrub nurse and an eventual assistant are on the other side of the operating table. A 0° camera is used. Pneumoperitoneum is created with an open technique; a small subumbilical incision is performed and taken down behind the umbilical skin to the linea alba, which is then divided, and the peritoneum is opened. A Hasson-type optical cannula is then inserted and held in place by sutures.

Apart from the Hasson cannula (optical port), two other operating ports are used: one 10-mm in the epigastrium and one 5-mm between the Hasson cannula and the 10-mm epigastric port. The Hartmann pouch is grasped and flipped cephalad toward the patient's right shoulder with a grasper introduced in the 5-mm port, achieving a complete exposure of the triangle of Calot. When a correct dissection of the cystic pedicle is not technically feasible, an eventual fourth 5-mm port is inserted in the right flank; the fundus of the gallbladder is then grasped by the assistant and flipped upwards- and over the superior edge of the right hepatic lobe, leaving the left hand of the surgeon free to achieve a better exposure of the triangle of Calot.

The dissection of the cystic pedicle is carried out with the dissector, using electrocautery sparingly, to prevent the occurrence of a bile duct injury. The incision on the peritoneal reflection of the gallbladder starts medially. The cystic artery and cystic duct are clipped (double proximal and single distal clips) and then divided by scissors. The detachment of the gallbladder from the liver is also performed with an electro-surgical hook knife, starting medially but using the flag technique to detach the lateral reflection of the peritoneum. Finally, the gallbladder is extracted through the Hasson port inside a bag.

The final step consists of inspection of the stumps of the cystic artery and duct and the gallbladder bed. The right parahepatic space is irrigated with normal saline until the returning fluid is clean. Fascial closure of the Hasson port is performed with absorbable sutures, and all port wounds are infiltrated with long-acting local anesthetic (bupivacaine, 0.25%).

Procedure of the "French" approach with three ports

The "French" technique is performed as detailed by Cuschieri.¹ In our case we performed it using only three ports, avoiding the insertion of the subxiphoid 5-mm one; a subumbilical Hasson port, a 10-mm port inserted in the left hypocondrium, and a 5-mm one inserted in the right flank are used. Pneumoperitoneum is created with the open technique and insertion of a Hasson-type cannula. Dissection of the cystic pedicle, detachment and extraction of the gallbladder, irrigation, fascial closure and anesthetic infiltration are performed similar to the already described three-midline-ports technique.

Routine intraoperative cholangiography is not performed in any of the approaches. The indications to carry out this procedure are the suspicion of intraoperative common bile duct injury or a history of choledocolithiasis or acute pancreatitis without having undergone endoscopic retrograde cholangiopancreatography preoperatively. The cannulation of the cystic duct for transcystic intraoperative cholangiography can be easily performed in both techniques.

Variables

The investigated clinical variables were age, gender, comorbidities, number of ports used, operation time, complication and mortality rates, and hospital stay. Postoperative pain was evaluated 24 hours after surgery with a visual analog scale (VAS); the pain sensation was investigated separately for the most painful port and for the addition of the pain sensation of all the ports (total pain).

Statistics

Statistical analysis was performed with the statistical software SPSS version 19.0 for Windows (SPSS, Inc., Chicago, IL). Quantitative variables that followed a normal distribution were defined by the mean and SD. For non-Gaussian variables, the median and range were used. Qualitative variables were defined by number and percentage of cases.

Comparison of variables were performed with a Student's *t* test, analysis of variance, and the Pearson correlation method for quantitative variables following a Gaussian distribution. Nonparametric tests (Mann-Whitney, Kruskal-Wallis, and Spearman correlation) were used for non-Gaussian variables. Comparison of qualitative variables was performed with the chi-squared test. *P* < .05 was regarded as significant.

Results

Fifty patients were included in each group. Age, gender, and co-morbidities were similar between the two groups, as described in Table 1. Mean operation time was 70.1 ± 19.15 minutes in Group 1 versus 65.9 ± 17.03 minutes in Group 2 (not significant). Complications appeared in 1 patient (2%) in each group: in Group 1 an iatrogenic lesion of the common bile duct, intraoperatively detected and solved by performing

TABLE 1. CHARACTERISTICS OF THE PATIENTS

	<i>French technique</i>	<i>Three-midline-ports technique</i>	<i>P</i>
Age	55.9 ± 15.9	61.25 ± 13.43	.143
Male/female	30%/70%	30%/70%	1
Obesity	20%	26%	.557
High blood pressure	10%	16%	.573
Diabetes mellitus type 2	10%	8%	.782
Cardiopathy			
Ischemic cardiopathy	2%	8%	.332
Atrial fibrillation	6%	2%	.484
Chronic obstructive lung disease	0%	2%	.127
Chronic renal failure	2%	4%	.274
Neuropathy (stroke)	2%	0%	.127

There were 50 patients per group.

TABLE 2. DISTRIBUTION OF MOST PAINFUL PORTS

	<i>French technique</i>	<i>Three-midline-ports technique</i>
Subumbilical port	56%	64%
10-mm port	32%	20%
5-mm port	12%	16%

$P = .03$.

an hepaticojejunostomy and in Group 2 an acute pancreatitis secondary to residual choledocolithiasis that was satisfactorily managed with conservative treatment. There was no mortality. Median hospital stay was 1.5 days in both groups.

Median total postoperative pain (addition of the pain of all ports) evaluated by VAS was 4 (range, 1–7) in Group 1 and 2.5 (range, 0–4) in Group 2 ($P = .002$). The most painful ports are summarized in Table 2. In both groups, the subumbilical port was the most painful in most patients, followed by the 10-mm port and the 5-mm one. The 10-mm port was the most painful one in Group 1 in 32% of the cases versus 20% in Group 2 ($P = .03$). Regarding the pain evaluation of each port separately, median VAS was 3 for the subumbilical port in both groups (not significant), 2.5 in Group 1 versus 1.5 in Group 2 for the 10-mm port ($P = .04$), and 1 for the 5-mm port in both groups (not significant) (Table 3).

Discussion

Advances in minimally invasive surgery have been focused on the reduction of the number of ports and their placement in occult locations, mainly for aesthetic reasons, but also to reduce the surgical aggression and therefore the postoperative pain. In this way, some approaches have been developed, such as natural orifice transluminal endoscopic surgery (NOTES),⁷ with the transvaginal approach being the most widely accepted to date, and single-incision laparoscopic surgery (SILS). The latter has gained many adherents for the performance of laparoscopic cholecystectomy in the last few years, based on the performance of a unique incision of 3 cm in the umbilicus that remains completely occult and allows the introduction of a device that represents an entrance for three ports.⁸ The main disadvantages of SILS are the higher costs because a special device and its specific surgical instruments are required and that a learning curve is necessary to adapt to the new position, which is uncomfortable for many surgeons because of the proximity of the ports.^{9,10}

The three-midline-ports approach was described in 1998 for laparoscopic-assisted colectomy, illustrating the advantage of the incorporation of the port sites into a midline laparotomy of approximately 3 inches long for bowel resection and anastomosis. As a result, the total length of the abdominal wall incision

TABLE 3. MEDIAN VISUAL ANALOG SCALE EVALUATION OF PAIN AT EACH PORT

	<i>French technique</i>	<i>Three-midline-ports technique</i>	P
Subumbilical port	3	3	.886
10-mm port	2.5	1.5	.04
5-mm port	1	1	.759

was smaller, and cosmesis was superior, while the performance of the technique was relatively simple.¹¹ In our opinion, the three-midline-ports approach for laparoscopic cholecystectomy is as comfortable as the conventional techniques for laparoscopic cholecystectomy and allows the use of normal laparoscopic instruments. Both the French and American trocar positions during laparoscopic cholecystectomy take advantage of the “triangulation effect,” a concept that is common to any other laparoscopic operation, whereby the scope is located between the two working instruments. This improves the ergonomics of the operation, which is important in every case and particularly so in more difficult cases.¹ In any case, the “triangulation effect” with the scope located between the two working instruments is not used in frequent laparoscopic approaches, such as colectomies or appendectomies, and the exposure and the dissection are safely performed. In our opinion, this port-site position allows an excellent exposure and dissection of the triangle of Calot. However, the main advantage of this approach, based on our results, is less postoperative pain compared with the “French” technique with three ports. It is widely accepted that the smaller the incision, the less the postoperative pain.¹² However, with the same number and size of incisions, but located in different places, the total perception of pain was significantly higher in the patients undergoing the French approach, showing that the pain perception is also associated with the port-site placement.

Analyzing separately the pain perception of each port, according to the previous assumption related to the incision size, the most painful port in most cases among both groups was the subumbilical one; thus it is the bigger incision performed, and there were no significant differences between the two groups. Notwithstanding, it is remarkable that the 10-mm port appears to be the most painful in the “French” approach, compared with the three-midline-ports technique, and the perception of pain associated with this port is significantly higher (2.5 in Group 1 versus 1.5 in Group 2; $P = .04$). The difference between both groups is only the location of the port: in the three-midline-ports technique the port is placed in the linea alba, whereas in the “French” approach it is introduced in the left hypocondrium. Anatomically, the linea alba of the abdomen is the place where the anterior and posterior layers of the rectum muscles coalesce. In this location, there are no muscular fibers, and therefore the insertion of a port is less traumatic. Moreover, nociceptive nerve fibers of the skin, fascia, and muscle are involved in the development of postoperative pain; in the linea alba, as explained before, there are no muscular fibers, resulting in a lower pain if a port is inserted in this location.¹³

To our knowledge, the three-trocar midline approach has been only previously described for colectomy, but these authors did not discuss about the postoperative pain.¹¹ So this is the first study evaluating the pain perception depending on the port-site placement and observing a lower pain perception when the ports are located in the linea alba. More studies should be conducted in the future to confirm this hypothesis.

Conclusions

The three-midline-ports approach is a feasible, safe, and easy-to-implement technique and is associated with less postoperative pain than the “French” approach with three ports. Special devices are not required, and therefore this approach is not associated with higher costs. More studies

with larger samples should be conducted to confirm these results, in order to include the three-midline-ports approach as a standard alternative technique to the "French" and "American" ones.

Disclosure Statement

No competing financial interests exist.

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