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Minimization of Approaches in Laparoscopic Cholecystectomy

Objective: the aim of the study was to estimate the influence of a number of endoscopic approaches on the effectiveness of laparoscopic cholecystectomy.

Methods: retrospective analysis of case histories of 118 patients was applied for the purpose of comparative evaluation of the results of surgical treatment using a three- and four-port laparoscopic approach. Patients were divided into two groups: patients operated using three-port laparoscopic approach (n=60 patients) and patients operated using four-port approach (n=58 patients). One of the important stages of studies was histomorphological characterization of the removed gallbladder, which was performed in all 118 patients who underwent minimally invasive operations. Conventional visual analogue scale of pain (VAS) was used for the subjective assessment of pain syndrome manifestations. **Results:** 60 patients underwent three-port laparoscopic cholecystectomy (LC) (main group) and 58 patients underwent four-port LC (control group). In the main group, 53 (88.3%) patients showed the absence of any pain, only 3 of them reported mild pain, and 4 – moderate pain, respectively, on the 7th day after surgical intervention. In the control group, these parameters were 50 (86.2%), 2 and 6 subjects, respectively. Terms of hospitalization and disability were relatively lower at the minimal number of ports: 3.2 and 4.4 days, respectively. Disability duration in the main group was 8.5 days versus 10.6 days in the control group. **Conclusion:** three-port laparoscopic approach technique allows significantly reducing the rate of pain syndrome clinical manifestations, achieving maximal cosmetic effect, and considerably shortening postoperative rehabilitation period, thus resulting in earlier activation of patients and restoration of their working capacity.

Key words: laparoscopic cholecystectomy, endoscopic approach, verification, pain.

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Background

Minimally invasive techniques used in practical medicine, especially abdominal surgery, gained global widespread acceptance thanks to the presence of certain advantages over conventional surgical interventions, due, first of all, to the simplicity and availability of techniques, considerable decrease in rate of complications, shortening of hospitalization and rehabilitation period duration, time of surgical intervention, as well as pronounced cosmetic effect [1–3]. At the same time, owing to development and introduction into surgical practice of novel, superior engineering devices, attempts to further minimize this procedure due to decrease in number of trocars used are continued [4–8]. Currently, the capabilities of these surgical technologies are still the focus of attention of foreign and domestic scientists [9].

The goal of the study consisted in the assessment of the effect degree of the number of endoscopic approaches on the efficacy of laparoscopic cholecystectomy.

Methods

Study design

Non-randomized controlled clinical study.

Inclusion criteria

The study included 118 patients hospitalized due to cholelithiasis who underwent surgical therapy.

Conditions

The study was conducted in the Military Hospital of the State Border Service of the Republic of Azerbaijan.

Study duration

The study was conducted during the period from February 2011 till April 2013.

Description of medical intervention

Before the operation, each patient underwent the relevant complex of examinations including general physical examination, laboratory testing, ultrasonic examination of abdominal cavity organs, CT, ECG, radiography of thorax organs; optional MRI if advanced examination of biliary ducts was required; endoscopic retrograde cholangiopancreatography.

Three trocars introduction technique: the first 5-mm trocar was introduced through a 5-mm incision directly over the umbilicus. After abdominal cavity examination in carboperitoneum conditions (12–14 mm Hg), a hypothetical line is drawn on the skin at the bladder neck level, which should be located about 5 cm below the ensiform cartilage. An incision of 10–12 mm in length is made 1 cm on the right from this centreline, parallel to costal arch. A 10-mm trocar is introduced into the abdominal cavity so that the umbilical fissure would be located on the left from the abdominal cavity entry site. The third trocar (5 mm) is introduced using a skin incision approximately under the bladder fundus projection, 1–2 cm below the costal arch angle. If the fourth 5-mm trocar is required, it should be introduced at the level between anterior axillary longitudinal line and mid-clavicular line; along the cross-line, it has to be located below or at umbilical level (Fig. 1 and 2).

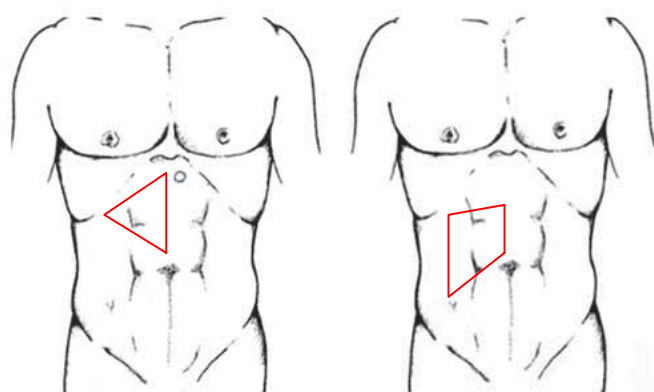
Study methods

Conventional visual analogue scale of pain (VAS) was used for the subjective assessment of pain syndrome manifestations [10]. A patient during follow-up period marked the degree of pain sense by a point on a straight 10 cm line. The start point of the line designated the complete absence of pain (0); marks designating mild, moderate, and severe pain are located further, and the maximal value indicating insupportable pain according to the patient comprised 10 (Fig. 3).

Statistical analysis

Sample size calculation method

No preliminary calculation of sample size was performed.



Note: a) three trocars; b) four trocars.

Fig. 1. Location of trocars (schematic view).



Fig. 2. Laparoscopic cholecystectomy with three trocars.

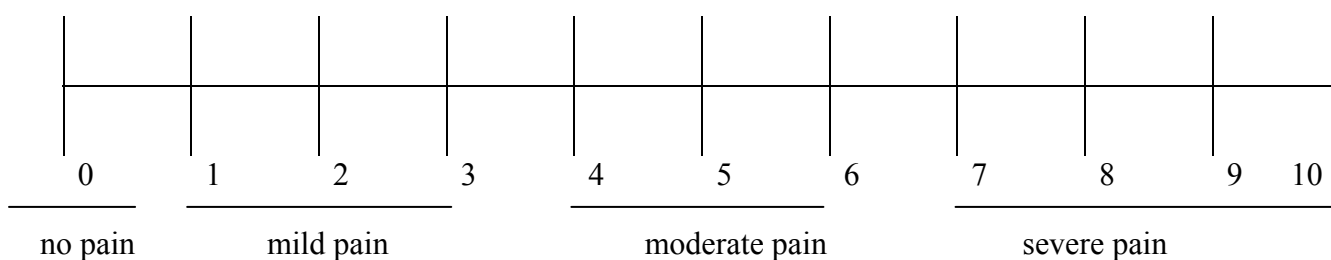


Fig. 3. Visual analogue scale of pain syndrome intensity.

Statistical analysis methods

Statistical processing of data was performed on a PC using a spreadsheet program Microsoft Excel 2007 and statistical software package STATISTICA v. 7.0 (StatSoft Inc., USA). The study results were processed by variation statistics methods. In order to characterize a group of homogenous units, their mean arithmetic values (M) and standard errors (m) were calculated. The study of qualitative attributes included determination of absolute sizes of groups, their proportions expressed as percentage; the qualitative attribute rate was characterized by its mean error. Parametric Student's t-test was used for data statistical processing. As the normal distribution condition was not met for studied groups, nonparametric Mann-Whitney U-test was used for statistical processing of VAS data between the two groups. The differences were considered statistically significant at $p < 0.05$.

Results

Study subjects

Retrospective analysis of case histories of 118 patients (25; 21.2% - men, 93; 78.8% - women), referring to the clinic during the period from February 2011 till April 2013, who underwent 118 laparoscopic cholecystectomies, was used for the comparative assessment of the results of surgical interventions performed via three- and four-port laparoscopic approach. Two patient groups were formed: the main group included 60 patients who underwent laparoscopic cholecystectomy by a 3-port approach, and the control group included 58 subjects who underwent cholecystectomy by a 4-port approach. Of the total number of patients ($n = 118$), the acute inflammatory process occurred in 12 subjects, chronic one – in 101 subjects, and gallbladder polyposis was diagnosed in 5 patients.

In 10 (8.5%) subjects, cholelithiasis was complicated with choledocholithiasis. Gangrenous cholecystitis was diagnosed in 3 (2.54%) patients, phlegmonous cholecystitis – in 9 (7.6%) patients, chronic cholecystitis – in 77 (65.3%) patients, chronic cholecystitis exacerbation – in 24 (20.33%) patients, and gallbladder polyposis – in 5 (4.23%) patients (Table 1). Patients' age

varied from 29 to 75 years old (Table 2). Mean duration of patients' stay in the hospital was 3.0 bed days. The gallbladder wall thickness was 2–4 mm in 99 (83.9%) patients, 4–8 mm in 16 (13.6%) patients, and more than 8 mm in 3 (2.5%) patients. The hepatolith size was less than 10.0 mm in 54 (45.8%) patients, 10.0–15.0 mm in 28 (23.7%) patients, 15.0–20.0 mm in 16 (13.6%) patients, and more than 20.0 mm in 20 (16.9%) patients.

Histomorphologic testing of removed gallbladder preparations for the purpose of verification of the data collected basically confirmed ultrasonic diagnostics results [11].

Table 1. Results of histological testing of subjects' gallbladders

Cholecystitis forms	Number of tests	
	Absolute	%
Gangrenous	3	2.54
Phlegmonous	9	7.63
Chronic	77	65.3
Chronic cholecystitis exacerbation	24	20.3
Gallbladder polyposis	5	4.23
Total	118	100

Table 2. Age-specific distribution of patients

Age groups	Number of patients	
	Absolute	%
Younger than 35 years of age	28	23.7
35 – 45 years of age	31	26.3
46 – 50 years of age	15	12.7
51 – 60 years of age	21	17.8
Older than 60	23	19.5
Total	118	100

Table 3. Visual analogue scale parameters in laparoscopic cholecystectomy

Period, days	Main group (n=60)	Control group (n=58)
1-st	3.90±0.11	4.10±0.10
3-rd	1.85±0.12	2.40±0.12*
7-th	-	0.10±0.04

Note * - parameter difference versus the main group is statistically significant ($p<0.010$).

Main study results

Visual analogue scale parameters in laparoscopic cholecystectomy are shown in Table 3.

The results obtained during morphological examination of gallbladders removed via laparoscopic cholecystectomy are indicative of the most frequent development of chronic cholecystitis in examined patients (101; 85.6%) with certain typical morphological signs: atrophy of gallbladder mucosa, mild or moderate lymphocytic-plasmocytic infiltration. As a rule, focal sclerosis was seen in sub-mucous membrane and sometimes in muscular layer. Metaplastic changes in epithelium were seen in case of chronic cholecystitis (Fig. 4). Antral type metaplasia occurred in 9.63% of cases. Besides that, intestinal metaplasia was detected only in 4 cases (0.98%), endocrine cell metaplasia – in 2 cases (0.49%), and squamous metaplasia – in 1 case (0.24%).

Rokitansky-Aschoff sinuses coated with epithelial cells, expanding from mucous membranes to deeper gallbladder wall layers, were observed in 85.6% (101 of 118) cases of chronic

cholecystitis development. Morphological signs of other pathologic conditions (in particular, polyposis) in removed gallbladder preparations were observed relatively rare – these were seen in 5 (4.2%) patients. Macroscopically, polyps were located in gallbladder body and fundus. In accordance with microscopic examination results, the cores of polyps were represented by multiple foamy macrophages – xanthome cells. These cells, containing high levels of cholesterol in cytoplasm, had distinct cellular membranes and nuclei upon hematoxylin and eosin staining (Fig. 5).

The surface of polyps, as well as mucous membrane of normal gallbladder, is coated with single-layer cuboid and columnar epithelial cells. The mucous membrane was velvety in all cases. Mean gallbladder wall thickness was 1.88 ± 0.33 mm. Dys- or metaplasia was detected in epithelium in none of the polyp cases.

Comparative analysis of the efficacy of performed surgical interventions and evaluation of therapy results in patients of study groups was carried out with consideration of surgical intervention time, postoperative course, hospitalization terms, cosmetic result, and intensity of postoperative pain syndrome.

Surgical intervention duration had no essential differences and depended on anatomic variants, inflammation process degree in hepatopancreatoduodenal area, and time required for hemostasis. Mean surgery time for three-port laparoscopic cholecystectomy was 30.6 ± 0.04 versus 35.2 ± 0.10 min for four-port laparoscopic cholecystectomy (surgery time was recorded from the beginning of puncture start using Veress needle till the last trocar removal from the wound).

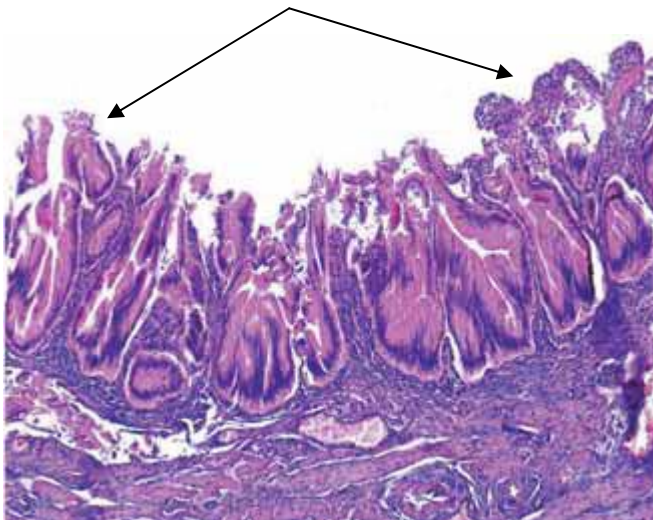


Fig. 4. Antral type metaplasia in gallbladder mucous membrane (mucosa site between two arrows). Hematoxylin and eosin staining. Magnification $\times 100$.

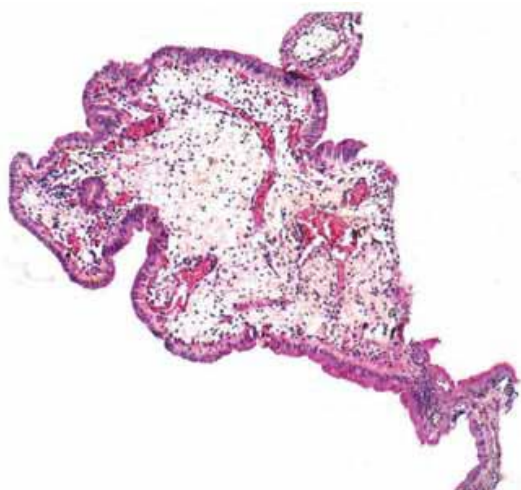


Fig. 5. Cholesterol polyp. Hematoxylin and eosin staining. Magnification $\times 40$.

Note: Outer polyp layer is coated with single layer epithelium, and its core is comprised of multiple foamy macrophages.

Table 4. Comparative efficacy of various laparoscopic cholecystectomy techniques

Assessment parameters	Main group (n=60)	Control group (n=58)
Hospitalization duration, days	3.2 \pm 0.10	4.4 \pm 0.16*
Disability duration, days	8.5 \pm 0.06	10.6 \pm 0.14*

Note: * - parameter difference versus the main group is statistically significant ($p < 0.001$).

Table 5. Nature of pain senses in various subject groups

Pain symptom	Main group (n=60)		Control group (n=58)	
	Abs.	%	Abs.	%
Absence of pain	53	88.3	50	86.2
Mild pain	3	5.0	2	3.4
Moderate pain	4	6.7	6	10.3

During the first day after surgical intervention, pronounced postoperative pain syndrome occurred in both patient groups. On day 3, considerable arrest of pain senses was observed; this trend was more prevalent in the main patient group operated via three-trocar approach (see Table 3).

For postoperative pain syndrome control, intramuscular injections of Tramal (100 mg) and Ketonal (100 mg) were administered every 6 and 8 h, respectively, during the first 24 hours following surgery. In the control group of patients, duration of analgesics dosage exceeded this parameter for the main group of patients by about 1 day.

Hospitalization and disability terms were relatively shorter in case of minimal number of ports (Table 4). Hospital stay time for patients operated using three ports was shorter compared to convenient four-port technique and comprised 3.2 and 4.4 days, respectively.

53 patients of the main group had no pain senses at all, and only 3 (5.0%) and 4 (6.7%) of them reported mild and moderate pain syndrome, respectively, on day 7 following surgical intervention (Table 5). Complete absence of pain syndrome signs in the group of patients where an additional fourth trocar was used for gallbladder removal, was registered in 50 (86.2%) cases; 2 (3.4%) and 6 (10.3%) patients reported mild and moderate pain, respectively (see Table 5).

Adverse events

No adverse events were reported.

Discussion

In the era of laparoscopic surgery, decrease of postoperative pain syndrome intensity and rapid recovery of patients is the doctor's main goal. Studies aimed for comparison of three- and four-trocar laparoscopic cholecystectomy have shown the absence of considerable differences in surgery duration, rate of success, need in anaesthesia, and postoperative patients' stay in the hospital [8, 12], though some surgeons express fear as to safety of decreasing the number of ports, alleging that it may result in increase in number of bile duct damages and other complications [13, 14]. Our study has not shown that the decreased number of ports results in increased rate of complications. An additional fourth port was not required in any of the cases of three-port laparoscopic cholecystectomy in order to complete the procedure.

No common bile duct damages or fatal outcomes were observed in any of the groups. Selection of the number of ports depends on thorough preoperative examination, history and laboratory data, gallbladder inflammation intensity, adhesive process level in subhepatic space, and patient's age. Majority of patients in both groups reported satisfaction with surgical intervention results and its aesthetic outcomes. The cosmetic effect was greatly superior in the group of patients exposed to three-port laparoscopic cholecystectomy.

Some of the studies have shown that the reduction of postoperative pain intensity was directly related with decrease of either size or number of ports [15, 16]. S. Trichac mentions safety and advantages of three-port laparoscopic cholecystectomy from the viewpoint of the use of analgesics, but he does not confirm shortening of postoperative stay in the hospital [8]. In accordance with the results of our study, patients exposed to the three-port procedure required less analgesic agents versus those who had the four-port procedure. Similar results were demonstrated by scientists from Ireland, Nepal, and other countries [15, 16].

Conclusion

Three-port laparoscopic approach technique allows significantly reducing the rate of pain syndrome clinical manifestations, achieving maximal cosmetic effect, and considerably shortening postoperative rehabilitation period, thus resulting in earlier activation of patients and restoration of patients' working capacity.

Conflict of interest

The author of this paper has confirmed the absence of reportable financial support / conflict of interest.

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