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SURGICAL RESEARCH

RANDOMIZED, PROSPECTIVE COMPARISON OF POSTOPERATIVE PAIN IN LOW- VERSUS HIGH-PRESSURE PNEUMOPERITONEUM

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Background: Reduced postoperative pain after laparoscopic cholecystectomy (LC) compared to open cholecystectomy (OC) may be able to be further optimized. To reduce pain, focus should be directed on the effects of individual components of pain.

Methods: A double-blind, randomized, controlled trial was carried out in a tertiary care hospital. Fifty-three elective patients with symptomatic gallstones were enrolled into the study. Patients were randomized to low- or high-pressure pneumoperitoneum groups. In all patients, gas pressure was set to 15 mmHg during placement of ports. Later on, in the low-pressure group, the rest of the procedure was performed at 10 mmHg pressure. At 6 and 24 h postoperatively, a short-form McGill Questionnaire (MPQ) was obtained from all patients. Patients were then asked to complete a 10-cm visual analogue scale (VAS) for abdominal pain.

Results: Pain scores were generally low for both groups. Statistical comparisons of mean cumulative McGill score and VAS abdominal pain scores in both groups did not reach statistical significance at 6 and 24 h after operation.

Conclusion: There was no correlation between high- and low-pressure laparoscopy and postoperative pain after LC. Peritoneal stretching may be more responsible for shoulder pain but has less effect on intensity of abdominal pain or incisional pain. On the basis of these negative findings, routine use of low-pressure pneumoperitoneum for alleviation of postoperative pain following LC is not recommended.

Key words: laparoscopic cholecystectomy, pneumoperitoneum.

Abbreviations: LC, laparoscopic cholecystectomy; MPQ, McGill Pain Questionnaire; OC, open cholecystectomy; VAS, visual analogue scale.

INTRODUCTION

Within an exceptionally short time, laparoscopic cholecystectomy (LC) has widely replaced open cholecystectomy (OC) as the standard treatment for symptomatic cholelithiasis. The duration of convalescence is a common measure of surgical outcome when different surgical techniques are compared. Although several factors such as components of individual, surgical procedures, surgical stress response, fatigue and sleep disturbances, postoperative nausea–vomiting, social cultural and medical traditions influence the time frame for return to normal activities, pain is probably the most important physiological reaction responsible for postoperative convalescence and overnight hospital stay on the day of operation in 26%–41% of patients.[1–4]

Reduced postoperative pain after LC compared to OP seem to have not satisfied surgeons, therefore trials for improvements in the treatment of postoperative pain for patient comfort are ongoing. To reduce pain, focus should be directed on the effects of individual components of pain.

These pain components are parietal pain, visceral pain as a result of surgical handling, and diaphragmatic irritation from the dissolved carbondioxide, and shoulder pain, presumably referred visceral pain.[5,6] Visceral pain and shoulder pain account for most of the pain experienced after LC, whereas patients complain more of the parietal pain after laparotomy.[7]

Pain is a subjective sensation, and its measurement and analysis are difficult. Pain scores recorded in randomized trials with elimination of observer and patient factors are of great value. Visual analogue scale (VAS) and McGill Pain Questionnaire (MPQ) have become the most widely used tests. The VAS is usually presented as a 100-mm horizontal line on which the patient's pain intensity is represented by a point between the extremes of 'no pain at all', and 'worst pain imaginable'. Its simplicity, reliability, and validity, as well as its ratio scale properties make VAS the optimal tool for describing pain severity or intensity.[8] The VAS score reflects the degree of pain severity at the time of assessment during the patient interview and therefore may bear little resemblance to the pain received earlier. The VAS is thought to be more sensitive for detection of small differences in pain levels.[8–12] Standard long-form MPQ takes 5–10 min to administer, which is too long for some studies. Therefore, a short form was developed. It takes approximately 2–5 min to administer and appears to be a useful instrument that provides information on the sensory, effective and overall intensity of pain.[13,14] Another method of pain measurement is the dose of analgesics.[15,16]

Therefore the purpose of the present paper was to test the influence of low-pressure pneumoperitoneum on the intensity of postoperative pain in patients undergoing LC.

METHODS

Approval for the study was obtained from the local ethics committee and all patients were given informed consent to be included in the study. Fifty-three American Society of Anesthesiologist

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(ASA) physical status I, II, III elective cases referred to the Ankara Numune Training and Research Hospital between January and October 2002, for symptomatic gallstones confirmed by abdominal ultrasonography were enrolled into study. Exclusion criteria included acute cholecystitis, acute pancreatitis, ASA stage IV, V, need for common bile duct exploration, or another surgical procedure, and treatment with drugs that influence neurohormonal parameters. All patients were admitted to hospital the day before surgery. Operations were performed after an overnight fast. To eliminate the bias caused by preoperative expectation, patients were randomized to low- or high-pressure pneumoperitoneum groups by closed envelope method in the operating room prior to surgery. In the low-pressure group, patients underwent LC with a short period of 15 mmHg pressure during the port insertion, followed by 10 mmHg pressure CO_2 pneumoperitoneum for the remainder of the operation. In the high-pressure group, patients had 15 mmHg pressure CO_2 pneumoperitoneum for the whole operation. Three patients required conversion to laparotomy (two for dense adhesion and one for technical problems). After exclusion of these three patients, 50 cases were available for analysis; 25 in the low-pressure and 25 in the high-pressure group.

All the surgical procedures were performed under standard general anaesthesia, by surgeons experienced in LC. Pneumoperitoneum was created with CO_2 insufflation using a Veress needle placed periumbilically. The intra-abdominal gas pressure and total volume of gas delivered during the operation were monitored. In all patients the gas pressure was set to 15 mmHg during placement of ports. Later, in the low-pressure group, remainder of the procedure was performed at 10 mmHg pressure. Postoperative analgesia was standardized to 75 mg oral or i.m. diclofenac twice a day. But patients were also told that they could request further analgesics if pain worsened. Postoperative nausea was treated with antiemetics (metoclopropamide 20 mg i.v.). All the analgesic medications were recorded by nursing staff. Postoperatively all the patients were allowed to drink and eat when deemed appropriate. Ambulation was routinely encouraged and all patients were discharged when they felt pain free and were able to leave hospital.

At 6 and 24 h after operation, a short-form MGQ (SF-MGQ) was obtained from all patients by a research assistant who was blind to the group allocation of the patients. Patients were then asked to complete a 10-cm VAS for abdominal pain, starting at 0 for 'no pain' and ending at 10 cm for 'the worst pain imaginable'. The pain scale was constructed without numeration, allowing patients to mark a point along the scale that best represented their pain at that time.

Trial size 2

The number of patients required for the study was calculated on the basis of an 80% power to detect a significant difference in a major end-point such as decrease in postoperative VAS or MPQ scores at the 5% significance level. With a type I error of 0.05 and a type II error of 0.20, the necessary sample size would be 40 patients (20 patients in each group). Therefore, we enrolled 50 patients into the study.

Statistical analysis

All data were collected and analysed by using SPSS 11.0. For non-parametric data, statistical evaluations were performed with Mann–Whitney *U*-test between groups, and Wilcoxon test within the groups. The χ^2 and Fisher's exact tests were used to evaluate association between groups in contingency tables.

RESULTS

After exclusion of three patients, who required conversion to open procedure, data of 50 patients (41 female) were analysed. Patients were randomized into two groups. Patient data, physical status and clinical properties were similar in these two groups (Table 1). Pain scores were generally low for both groups. There was no significant difference of mean total McGill score between groups at 6 h postoperatively (7.9 ± 4.6 vs 9.5 ± 5.9). At 24 h after operation the mean total McGill score was 3.0 ± 2.2 in the low-pressure and 3.6 ± 0.2 in the high-pressure groups, and the difference was not statistically significant. For all components of the questionnaire, patients in the low-pressure group had significantly lower scores at 6 h (Table 2). One patient from each group had scores <2 (moderate) for all components of the questionnaire at 6 h after operation. At 24 h after operation, this number of patients increased to 16 in the low-pressure group and nine in the high-pressure group.

Statistical comparisons of mean VAS abdominal pain score in both groups did not reach statistical significance at 6 and 24 h after operation (Table 3). Within the groups there were significant decreases from 6 h to 24 h after operation confirmed by cumulative McGill score and VAS for abdominal pain.

Apart from pain scores, the duration of surgery and total gas volume were comparable in the two groups. There were no severe complications in either group. The majority of patients in both groups were able to return to oral food intake quickly after surgery, and the majority of patients were able to be discharged by the first postoperative day. There were no significant differences between groups in terms of time to return to oral food,

Table 1. Patient details for LC (mean ± SD)

	Low-pressure group (n = 25)	High-pressure group (n = 25)	P
Mean age (years)	46.3 ± 15.5	47.9 ± 15.2	NS
Female/Male	22/3	19/6	NS
WBC (median)	7300	8100	NS
Concurrent disease	10	8	NS
Mean volume of CO_2 (L)	28.3	39.2	NS
Operation time (min)	56.7 ± 19.2	59.4 ± 21.7	NS
Acute episode	7	5	NS

LC, laparoscopic cholecystectomy; NS, non-significant; WBC, white blood cell.

Table 2. McGill score after LC (mean ± SD)

Time after operation (h)	Low-pressure group (n = 25)	High-pressure group (n = 25)	P
6	7.9 ± 4.6	9.5 ± 5.9	NS
24	3.0 ± 2.2	3.6 ± 2.9	NS
P	0.01	0.01	

LC, laparoscopic cholecystectomy; NS, non-significant.

Table 3. Visual analogue scale for LC (mean ± SD)

Time after operation (h)	Low-pressure group (n = 25)	High-pressure group (n = 25)	P
6	3.8 ± 1.8	4.1 ± 1.8	NS
24	1.3 ± 0.9	1.7 ± 1.0	NS
P	0.01	0.01	

LC, laparoscopic cholecystectomy; NS, non-significant.

and discharge. During the first 24 h after operation, six patients in the low-pressure group and 10 patients in the high-pressure group required extra analgesic medication for strong pain; but extra analgesic reqirement was not significantly different between the two groups.

In comparison of 16 patients who required extra analgesics with 34 patients who did not, there was no significant difference in terms of demographic, clinical or operative data.

DISCUSSION

Although the pain that occurs after laparoscopy is significantly less and shorter than that caused by the same surgical procedure made by laparotomy, pain is still the most common complaint after elective LC.[5,15,17,18] Reporting of pain is greatest after operation and decreases to a low level within 24 h. Joris *et al.* reported that after LC, visceral pain was predominant in the first 24 h and subsided from a peak soon after operation, whereas shoulder pain was minor on the first day, increased and became significant on the following day.[5] Pain after LC is multifactorial in origin, being affected by patient demographics, nature of underlying disease, surgical factors, anaesthetic technique, and postoperative care. From a review of the literature, surgical factors that may influence the degree of pain after laparoscopic procedures include the volume of residual gas, the type of gas used for pneumoperitoneum, the pressure created by the pneumoperitoneum, and temperature of insufflated gas. The length of the operation and volume of insufflated gas may also be related to postoperative pain. Also several surgical factors such as port incisions, the use of intra-abdominal gas, and intra-abdominal surgical manipulation may influence pain after LC[19–21] or pneumoperitoneum causes pain related to surgical trauma during the procedure. We analysed the results for pain scores and analgesia requirements to determine any possible advantages of low-pressure pneumoperitoneum compared to high-pressure pneumoperitoneum. Pain scores were not significantly different among the groups. Although there are several trials that found results to the contrary, that is, that there was a correlation between peritoneal stretching and postoperative pain after LC, in the majority of them the pain components were not studied. Peritoneal stretching may be more responsible for shoulder pain but has less effect on intensity of abdominal pain or incisional pain.[3–5,22,23] In a prospective study a gasless wall-lifting technique for LC significantly reduced the incidence of shoulder pain but had no effect on overall intensity of pain.[24] Some authors propose that it may be the result of peritoneal irritation of a chemical nature caused by the insufflation with CO_2. Carbon dioxide may be transformed to an irritative carbonic acid by combining with fluid in the peritoneal cavity.[25] This opinion is supported by the observation that after LC, patients experience less pain if nitrous oxide is used instead of CO_2 as the pneumoperitoneum agent.[26] In the study by Aitola *et al*. patients undergoing laparoscopy with N_2O pneumoperitoneum had significantly less pain up to 24 h following the operation than patients who had CO_2 insufflation.[26]

Although the present study found no difference between low-pressure and high-pressure pneumoperitoneum in terms of duration of operation and complication, exposure was better with high-pressure pneumoperitoneum. On the basis of these negative findings, we do not recommend routine use of low-pressure pneumoperitoneum for alleviation of postoperative pain following LC.

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