Original Article

The comparison of pulmonary functions in open versus laparoscopic cholecystectomy

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Abstract

Objective: To examine respiratory functions of patients after open and laparoscopic cholecystectomy and to compare the advantages.

Methods: Fifty five cases with cholelithiasis subjected to elective cholescystectomy were studied. The patients were divided into two groups. Open Cholecystectomy (OC) was performed on 27 cases (Group I), and Laparoscopic Cholecystectomy (LC) in 28 cases (Group II). Respiratory function tests were performed 24 hours before the operation and on the 1st and 6th day after surgery. Blood gas values and anaesthesia periods were recorded. Forced expiratuary volume in the 1st second (FEV1), forced vital capacity (FVC) and FEV1/FVC values were also noted.

Results: FEV1, FVC and FEV1/FVC values on first post-operative day in all cases were statistically lower than the preoperative values (p=0.0001). Percentage changes of respiratory function test was calculated preoperatively and 1st postoperative day. The changes in both groups showed a significant decrease in FEV1, FVC and FEVI/FVC in Group I compared to Group II (p=0.0001 in FEV1, p=0.007 in FVC and p=0.004 in FEV1/FVC). There was no significant difference in respiratory function tests evaluated on the 6th postoperative day and they had returned to normal values. There was no difference among preoperative and postoperative PaCO2, pH values in arteriel blood gas values in all cases (p=0.355 p=0,215). These parameters did not differ in both groups (p=0.527, p=0.591), There was a significant decrease in PaO2 and O2 saturation in all cases (p=0.0001), but there was no significant difference when both groups were compared (p=0.166, p=0.678).

Conclusion: The better results of pulmonary function tests in patients subjected to LC proves the advantage of the procedure over OC (JPMA 59:201; 2009).

Introduction

Technologies as chemolithotripsy, lithotomy by shock waves, laser treatment and percutaneous drainage have been used to treat cholelithiasis. However most of them were discontinued due to a high relapse rate.[1,2]

Effective treatment of cholelithiasis is surgery and OC has been used successfully for years.[3] However, many surgical abdominal interventions were performed laparoscopically as a result of improvements in endoscopic surgery and LC is the golden standart in cholelithiasis treatment.[3] The advantages are a shorter surgery time, better cosmesis with a shorter hospitalisation, recovery and time away from work. Postoperative hernia rate is also minimum.[4,5]

Pulmonary complications are the first cause of morbidity after abdominal surgery. Furthermore, primary or secondary lung failure is the cause of 50% of mortality after surgery. Pulmonary dysfunction is observed after abdominal surgery due to factors like incisional pain, diaphragmatic dysfunction and deterioration in ventilation mechanism.[6,7] The purpose of this study was to examine respiratory functions of patients after open and laparoscopic cholesystectomy and to compare the advantages.

Patients and Method

A total of 55 patiens with chronic calcular cholecystitis who were scheduled for elective cholecystectomy, between June 2004 and March 2005 were included. The patients were randomised according to their hospitalisation sequence. They were divided into two groups. OC was performed in first 27 cases (Group I), and LC in next 28 cases (Group II). The study was approved by the Local Ethical Review Committee. All patients gave an informed consent.

The cases with acute cholecystitis and the ones operated with additional procedures were not included in this study.

Age, sex, height, weight, smoking habits and Chronic Obstructive Lung Disease (COLD) of both groups were recorded in preoperative period. BMI (Body Mass Index) and ASA (American Society of Anesthesiologists) scores of these patients were calculated.

The patients were divided into four groups according to BMI as healthy (18.5-24.9 kg/m2), overweight (25-29.9 kg/m2), obese (30-39.9 kg/m2), morbidly obese (over 40 kg/m2).

Prior to the surgery, patients with any pulmonary problems were given antibiotics, expectorant and bronchodilatator treatment for 1 week. Surgery was performed after recovery.

Respiratory function tests of the patients in standing postures were performed 24 hours before the operation and on the 1st and 6th day after the operation. Blood gas values and anaesthesia periods were recorded. Forced expiratory volume in 1st second (FEV1), forced vital capacity (FVC) and FEV1/FVC values were included in this study.

The same person tested every patient with a mobile hand spirometer (one flow spirometre; Clent Clarke 2002, made in UK) for respiratory function test. The best test results of patients were recorded for every parameter.

Average intraabdominal pressure was raised to 14 mmHg with CO2 insuflation in LC operations. Right subcostal insicion was used in OC operations.

All the patients were operated under general anaesthesia with endotracheal intubation by the same team. Postoperative analgesia(paracetamol 1gr/d) was given according to the need of every patient.

Statistics

Data analysis was prepared in SPSS 11.5 statistical package program. Sex, COLD and smoking habits and their homogenity are evaluated by Chi-square test. Age, height and weight homogenity was evaluated by Mann-Whitney U test or Students t test. Preoperative and postoperative values of blood gas and respiratory function tests were evaluated statistically by Wilcoxon signed-rank test among groups and all cases. Mann-Whitney U test was used to compare success in treatment strategies (similar comparison was made for smoking habits and COLD). Kruskal-Wallis test was used to compare BMI groups and anaesthesia period groups in respiration function. Significant group and groups were determined by Kruskal-Wallis multiple comparison tests. $P<0.05$ was accepted as significant.

Results

The demographic features of the patients of both groups are shown in Table-1.

Four cases (17,8 %) in Group I and 5 cases (15,4 %) in group II were smokers. The distribution was homogenous according to ASA classification. Mean anaesthesia period was 102 minutes (60-200 min.) for OC group and 57 minutes (30-95 min.) for LC group. There was no death in the series.

FEV1, FVC and FEV1/FVC values in all cases were statistically low compared to preoperative values on 1st day after the operation. (p=0.0001 for each value). Percentage changes of respiratory function test was calculated preoperatively and postoperative 1st day. The changes in both groups were compared and there was a significant decrease in

Table 1: Demographic and clinical features of patients.

	Group I (n=27)	Group II (n=28)
Sex (M/F)	11/16	7/21
Age (years)	53 (24-72)	51 (22-74)
Weight (kg)	75 (43-117)	79 (45-150)
Height (m)	1,62 (1,47-1,75)	1,61 (1,50-1,85)
COLD	4	5

COLD: Chronic Obstructive Lung Disease

FEV1, FVC and FEVI/FVC in Group I to Group II. (p=0.0001 in FEV1, p=0.007 in FVC and p=0.004 in FEV1/FVC) (Figure). There was 43 % in FEV1, 36 % in FVC, 4.7 % in FEV1/FVC decrease in Group I. There was 19 % in FEV1, 17 % in FVC and 2.5 % in FEVI/FVC decrease in Group II. There was no significant difference in respiratory function tests evaluated on the 6th postoperative day and they had returned to normal values (Table 2).

There was no difference among preoperative and postoperative PaCO2, pH values according to arteriel blood gas values in all cases (p=0.355 p=0,215). Also, these parameters did not differ when both groups were compared (p=0.527, p=0.591), There was a significant decrease in PaO2 and O2 saturation in all cases (p=0.0001), but there was no significant difference when both groups were compared (p=0.166, p=0.678) (Figure).

The only statistically significant decrease was in postoperative O_2 saturation values compared to preoperative values when percentage changes in respiratory

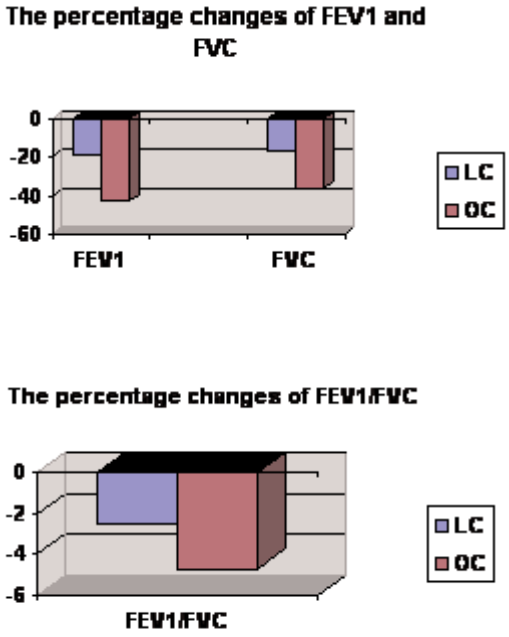

Figure: The percentage changes of FEV1/FVC and FEV1-FVC.

Table 2: Pulmonary function tests preoperative and postoperative day 1 and 6.

Paramaters	Open Cholecycstectomy (n=27)			Laparoscopic Cholecycstectomy(n=28)		
	Preoperative	Day 1	Day 6	Preoperative	Day 1	Day 6
FEV1 (L)	2,97	1,7	2,74	2,93	2,28*	2,81
FVC (L)	3,58	2,3	3,38	3,47	2,89*	3,42
FEV1/FVC	0,82	0,73	0,81	0,84	0,78*	0,82
PaCO2	36,2	38,2	37,4	35,8	37,4	36,2
PaO2	87,3	76,3	86,1	85,7	78,5	84,3
SaO2	98	88	97	97	89	96
PH	7,38	7,33	7,32	7,37	7,34	7,35

Values as median
* : p<0,05

function test and arteriel blood gas were evaluated in cases with Chronic Obstructive Lung Disease (COLD) (p=0.816 for FEV1, p=0.241 for FVC, p=0.957 for FEV1/FVC, p=0.099 for pH, p=0.101PaCO2, p=0.979 for PaO2 and p=0.039 for O_2 saturation) . This decrease was not significant in Group I (p=0.510) but it was significant in Group II (p=0.024) (Table 2).

There was a significant decrease in FEV1 and O_2 saturation when respiration function test and arterial blood gas values were compared preoperatively and postoperatively according to BMI in all cases (p= 0.047 for FEV1, p=0.410 for FVC, p=0.059 for FEV1/FVC, p=0.827 for pH, p=0.788 for PaCO2, p=0.572 for PaO2 and p=0.037 for O2 saturation). There was a significant decrease in FEV1 values in morbidly obese patients compared to overweight and obese patients. O2 saturation was lower in obese patients compared to normal weight patients. There was no significant difference between the results of Group I and II in BMI. (p=0.466 for FEVI,p=0.353 for O2 saturation in Group I, p=0.398 for FEVI, p= 0.099 for O2 saturation in Group II).

There was a difference only in FEV1 values when anaesthesia periods, respiration function test and arteriel blood gas values were compared in all cases. It was observed that the postoperatiave FEV1 values decreased compared to preoperative values, when the duration of anaesthesia was longer. (p=0.001 for FEVI, p= 0.263 for FVC, p=0.172 for FEVI/FVC, p=0.125 for pH, p= 0.327 for PaCO2, p=0.361 for PaO2 and p=0.552 for O2 saturation).

Discussion

Postoperative complications are very important in evaluating a surgical technique. Pulmonary complications are one of the leading causes of morbidity after major abdominal surgery. General anaesthesia has an important role in pulmonary complications, as there is a deterioration in gas change. This deterioration starts as a result of changes in lung volume, shunts, ventilation-perfusion, lung and chest wall mechanics.[6,8] This effect of general anesthetics is short and respiratory functions return to the baseline within 24 hours. Mean anaesthesia period for OC and LC was reported as 97-108 minutes in a study by Karayiannakis et al,[4] 90 and 90 minutes in a study by Hendolin et al,[9] 72 and 78 minutes in a study by Hasukic et al.[10] Anaesthesia period in our study was 102 minutes in OC and 57 minutes in LC. As it is understood from these studies that the more experience in LC leads to a shorter anaesthesia period. Anaesthesia period and percentage changes in preoperative and postoperative respiratory function tests and blood gas values showed that as anaesthesia period increased, FEV1 value decreased. A rapid decrease was seen in FEV1 in an anaesthesia after a period of more than 60 minutes. LC has more advantages compared to OC in short anaesthesia periods.

Upper abdominal surgery may cause deterioration in pulmonary functions independent from general anaesthesia due to a longer term effect on pulmonary functions which may last up to 10 days.[6,11] It is not possible to stop deterioration in respiratory function tests after general anaesthesia and abdominal surgery.[12] It was reported that all respiratory function test values become normal on postoperative 4-10th day.[6] Upper abdominal insicions effect pulmonary functions more than lower abdominal insicions.[10,13] This can be attributed to postoperative pain and diaphragma dysfunction.[4,13,14] Laparoscopy causes less damage to abdominal wall and less postoperative pain. The changes in ventilation mechanics and deterioration in postoperative oxygenation are reduced which leads to decrease in pulmonary complications.[4]

Frazee et al. compared respiratory function test after open and LC in 1990. In that study FEV1 and FVC values on the first postoperative day in OC group were significantly lower than the laparoscopic group.[15] This study and other sudies showed that there was less decrease in respiration function after laparoscopy.[16-19] Previous studies have reported 40-70 % decrease in FEV1 and FVC after OC and 20% decrease after LC.[4,6,9,15,17] In our study FEV1 decreased 43% and 19% and FVC decreased 36% and 17% after OC and LC respectively. These values are statistically significant and comparable with published results.

FEV1/FVC ratio helps to determine obstructive and restrictive anomalies. FEV1/FVC decreases in obstructive type but this ratio is normal or high in restrictive type.[15,20] Schauer et al. reported that postoperative FEV1/FVC values decreased after OC and remained such until 7th day and there was no significant decrease in this ratio after LC.[6] In a study by Mimica et al. FEV1/FVC was significantly low in both groups on the 6th hour, however, both of them returned to preoperative values on the 144th hour.[7] In a study by Karayiannakis et al. the change in FEV1/FVC ratio was very small in both groups and it was not statistically significant.[4] In our study FEV1/FVC decreased significantly in both groups and the decrease in OC was significantly more compared to LC. And the respiratory function tests had returned to normal values on the 6th postoperative day. This result supports the study by Mimica et al.

Mimica et al., also found no difference in pH, PaCO2 and HCO3 between laparoscopic and open groups. PaO2 value decreased in both groups, however this decrease was more significant in OC group than LC group. There was no significant change in O_2 saturation in LC group but there was significant decrease in OC group.[7] Karayiannakis et al. reported that there was no difference between two groups in pH and $PaCO_2$ and oxygenetion was better in LC.[4] Hasukic et al. also found no significant difference between the two groups in $PaCO_2$ and pH.[9] In our study PaO_2 and O_2 saturation decreased significantly in both groups. There was no significant difference in pH and $PaCO_2$ values and the results in both groups were similar. In studies when open and LC were compared, the results on blood gas values have been variable, but it is generally accepted that LC deteriorates blood gas values to a lesser degree.[4,7]

In previous studies older age together with Chronic Obstructive Lung Disease (COLD) has an important role on late term respiratory failure.[7,21] In our study there was no significant difference between the two groups with COLD related to respiratory function test. There was no significant decrease in O2 saturation in OC group but all LC group showed deterioration.

BMI did not have a significant influence on the respiratory function test and blood gas values. However, a significant decrease in FEV1 and O_2 saturation was observed in obese and morbidly obese patients in all cases. High BMI has a negative effect on respiration in both methods.[22]

The study observations proved that LC had more advantages compared to OC especially with regard to less pulmonary dysfunction and complications.

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