RESEARCH ARTICLE

Effect of Intra-Abdominal Pressure on Post-Operative Discharge Criteria in Laparoscopic Cholecystectomy

Faranak Behnaz[1], Navid Nooraei[1], Dariush Moghaddas[1], Seyed Amir Mohajerani[1]*

Background: Pneumoperitoneum results in respiratory and hemodynamic changes. It is unknown whether hemodynamic changes that last to the recovery room could change recovery criteria.
To determine the effect of decrease in intra-abdominal pressure on discharge criteria after laparoscopic cholecystectomy.
Methods: Patients with age 25-65 who were candidated for elective laparoscopic cholecystectomy were enrolled in the study. In high pressure group, intra-abdominal pressure was maintained at 12, and in low pressure group at 8 mmHg. Intra-abdominal insufflation was performed using CO2. After surgery, patients were transferred to recovery room. Heart rate, blood pressure, and pulse oxymetery monitoring were continued in recovery room and modified Aldrete scores were measured every 4 minutes. Patients were discharged from recovery if they had Aldrete score> 9.
Results: Aldrete scores were lower in high pressure group compared to low pressure group at 4 and 8 minutes in recovery room, however this difference was not significant (p=0.17, 0.44; respectively). At 12, 16, 20 and 24 minutes Aldrete scores were not significantly different between two groups (p> 0.05).
Conclusion: The effect of decreasing intraabdominal pressure from 12 to 8 mmHg during insufflations of CO2 in laparoscopy induces only minor non-significant decrease in discharge time and criteria.
Keywords: laparoscopy; cholecystectomy; pressure; abdominal

Pneumoperitoneum results in respiratory and hemodynamic changes. Pneumo-peritoneum decreases thoracopulmonary compliance. Capnography is an indicator of this increase, that reach plateaus after 20 to 30 minutes.

Peritoneal insufflation induces alterations of hemodynamics, that decreases cardiac output, elevates arterial pressure, and increases systemic and pulmonary vascular resistances. Hemodynamic changes are accentuated in high-risk cardiac patients. Peritoneal insufflation to IAPs higher than 10 mm Hg induces significant alterations of hemodynamics [1]. These disturbances are characterized by drop in cardiac output, arterial pressures rise, and increase in systemic and pulmonary vascular resistances. Heart rates remain unchanged or increased only slightly. The decrease in cardiac output is proportional to the increase in IAP. These adverse hemodynamic effects of pneumoperitoneum have been confirmed by studies using pulmonary artery catheterization [2], thoracic electrical bioimpedance [3], esophageal echo-Doppler, and transesophageal echocardiography [4].

The pathophysiologic hemodynamic changes can be attenuated or prevented by optimizing preload before pneumoperitoneum and by vasodilating agents, α2-adrenergic receptors agonists, high doses of opioids, and β-blocking agents.

Laparoscopy results in multiple postoperative benefits, allowing for quicker recovery and shorter hospital stay, which explain the increasing success of laparoscopy.

However, it is unknown whether hemodynamic changes that last to the recovery room could change recovery criteria. However, decrease in intra-abdominal pressure is accompanied with lower surgical field access.

To determine the effect of decrease in intra-abdominal pressure on discharge criteria after laparoscopic cholecystectomy

Methods

This is a double blinded randomized clinical trial. Fifty cases were randomly assigned to two groups of study, each had 25 cases based on accidental numbers assigned by computer to each case. In High pressure group intra-abdominal pressure was maintained at 12 mmHg and in low pressure group it was 8 mmHg. Study was performed in 2013 to 2014. Study was double blind as anesthesiologist performing evaluation during insufflation was blinded to the group of patients; and so was the anesthesiologist evaluating the patients in recovery room.

The study was reviewed and approved by the University Ethics Committee and has been performed in accordance. Information about the study was given comprehensively both orally and in written form to all patients or their

From the [1]Department of Anesthesiology and Critical Care, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
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*Corresponding author: Seyed Amir Mohajerani, MD, Department of Anesthesiology and Critical Care, Shahid Beheshti University of Medical Sciences, Tehran, Iran. E-mail: amirmhj@gmail.com

accompanying adult. They gave their informed written consents prior to their inclusion in the study.

Patients with age 25-65 who were candidated for elective laparoscopic cholecystectomy were enrolled in the study. Inclusion criteria were absence of severe cardiovascular disease, no diabetes, no consumption of calcium channel blocker, beta blocker or alpha 2 agonists. Exclusion criteria were severe bleeding or hemodynamic instability during surgery.

In high pressure group, intra-abdominal pressure was maintained at 12, and in low pressure group at 8 mmHg. Intra-abdominal insufflation was performed using CO2.

Induction was performed using 1.5 mg/kg propofol and 0.5 mg/kg cis-atracurium. Maintenance was performed using 1 MAC isoflurane and O2 50%/Air 50% to maintain BIS at 40-60; muscle relaxant was used at the 30-60 minutes interval and monitored by Train of four (TOF). All necessary monitorings were used including heart rate, blood pressure, pulse oxymetery, and end-tidal CO2 monitoring.

Laparoscopy was performed using Trichak 3 ports with insufflations of CO2. All intra-abdominal CO2 was disposed at the end of surgery.

After surgery, patients were transferred to recovery room. Heart rate, blood pressure, and pulse oxymetery monitoring were continued in recovery room and modified Aldrete scores were measured every 4 minutes. Patients were discharged from recovery room if they had Aldrete score>9.

Alderet score has 5 items which include are evaluating patients' activity, consciousness, blood pressure, respiratory, and color of patients.

Statistical calculations were conducted using SPSS 22 (Chicago, IL, USA). The parametric variables were presented as mean±SD and were analyzed by the Student t-test; non-parametric variables were analyzed by Mann-Whitney test. P<0.05 was considered as statistically significant. Sample size was estimated using sample size calculator software with 95% confidence interval, p=0.05 and power of 80% and difference between two groups of 30% in primary outcome based on pilot study.

Results

In this study 50 patients candidate for elective laparoscopic cholecystectomy were enrolled in the study and randomly assigned to 2 groups. Twenty-five patients were assigned to high pressure group and 25 to low pressure group. Age, sex, BMI, duration of surgery and anesthesia were not significantly different in two groups of study (Table 1).

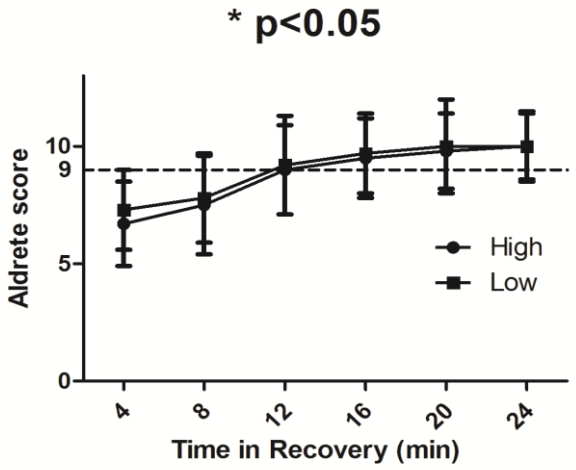
Table 1- Demographic characteristics of patients

variables	High	Low	p-value
Age (years)	45.6±7.5	47.2±8.4	0.56
Sex (female/male)	12/3	11/4	0.66
BMI (kg/m2)	25.2±4.6	24.9±5.2	0.35
Duration of surgery (min)	84.5±15.8	89.5±12.4	0.33
Duration of Anesthesia	100.4±18.6	104.3±24.6	0.65

Aldrete score

Aldrete scores were lower in high pressure group compared to low pressure group at 4 and 8 minutes in recovery room, however this difference was not significant (p=0.17, 0.44; respectively). At 12, 16, 20 and 24 minutes Aldrete scores were not significantly different between two groups (p> 0.05) (Figure1).

Figure 1- Comparison of Aldrete score in recovery between high and low pressure group.



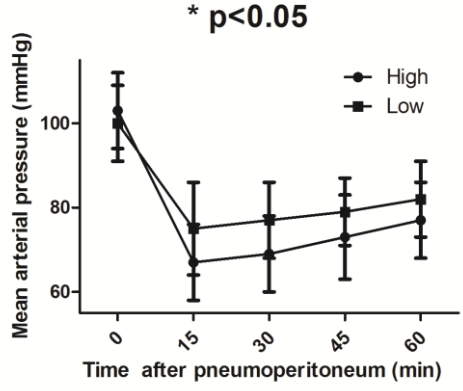
Time interval to reach Aldrete score> 9 was 10.8±3.6 in low pressure group and 12.5±3.4 in high pressure group which was not significantly different (p=0.19). Time to discharge from recovery was not significantly different between two groups of study (p=0.15) (Table2).

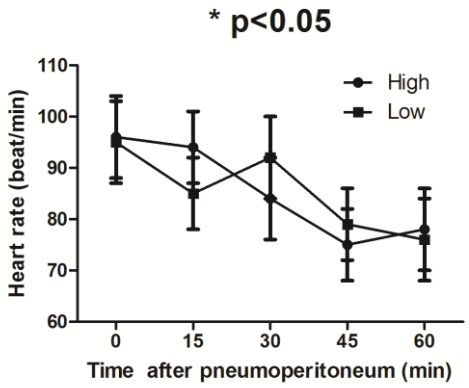
Table 2- Interval to reach Aldrete score and time to discharge from recovery

	High pressure	Low pressure	p-value
Interval to reach Aldrete score ≥9	12.5±3.4	10.8±3.6	0.19
Time to discharge from recovery	37.8±7.9	33.4±7.6	0.15

Blood pressure and heart rate of patients in both high and low group were not significantly different at any time point during and after surgery (p>0.05) (Figure 2).

Figure 2- MAP and heart rate after pneumoperitoneum





Post-operative side effects including PONV and pain frequency were determined; PONV incidence was not significantly different between two groups of study, however, incidence of post-operative pain was significantly lower in low pressure group compared to high pressure group (Table 3).

Table 3- Postoperative side effects

	High	Low	p-value
PONV	5 (33%)	4 (26%)	0.7
pain	10 (66%)	4 (26%)	0.028

Discussion

Laparoscopic cholecystectomy in opposite to open cholecystectomy is currently the main surgical technique for cholelithiasis [5]. Laparoscopic procedures have many advantages over open procedures such as lesser haemorrhage, better cosmetic results, less post-operative pain, shorter recovery time, and hospital stay [6].

However, laparoscopic procedure requires insufflations and therefore increases intraabdominal pressure. This increase in pressure induces prominent hemodynamic changes intraoperatively which linger to the recovery. Unopposed increase in intraabdominal pressure decreases venous return and causes drop in blood pressure. This drop if persists in recovery room could postpone patient's discharge from recovery room. Here in this study we embarked on the effect of decrease in intraabdominal pressure on discharge criteria and time to discharge from recovery. Our results indicated that a decrease from 12 mmHg to 8 mmHg of intraabdominal pressure during laparoscopy has minor effect on discharge criteria.

The principal findings of changes in cardiovascular function due to the insufflation are an immediate decrease in cardiac index and an increase in MAP and SVR. In the next few minutes there is partial restoration of cardiac index and resistance but blood pressure and heart rate do not change [7]. Laparoscopic cholecystectomy using pneumoperitoneum (CO_2 insufflation) may be associated with increased cardiac filling pressures and an increase in blood pressure and systemic vascular resistance due to increase in intrathoracic pressure [8]. In the pneumoperitoneum group PCWP, CVP, MAP and SVR were increased after CO_2 insufflation [9].

CO_2 insufflation produced impairment of the cardiopulmonary functions, which reduces SVR, MAP, CI and increases pulmonary pressures and vascular resistance, following induction of anesthesia. However, these effects tended to normalize over time [10]. In a systematic review, they showed that the use of low-pressure pneumoperitoneum has no clinical advantages as compared to standard pressure on cardiac and pulmonary function [11]. In another systematic review [12], the authors concluded that low pressure laparoscopic cholecystectomy can be completed successfully using low pressure in approximately 90% of patients.

In conclusion, the effect of decreasing intraabdominal pressure from 12 to 8 mmHg during insufflations of CO_2 in laparascopy induces only minor non-significant decrease in discharge time and criteria. However, these results could be enhanced if intraabdominal pressure changes are more prominent and accompany severe hemodynamic changes.

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