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Original Article

POST-OPERATIVE PULMONARY FUNCTION : A COMPARISON BETWEEN UPPER ABDOMINAL OPEN CHOLECYSTECTOMY AND LAPAROSCOPIC CHOLECYSTECTOMY

Shahnaz Afroza[1], M.M. Masum-Ul- Haque[1], Nibedita Nargis[1], Nezamuddin Ahmed[2], Lutful Aziz[3], KM Iqbal[4]

ABSTRACT:

Postoperative Pulmonary Complications (PPCs) is one of the major cause of perioperative mortality and morbidity in thoracic and upper abdominal surgery. Preoperative risk assessment enables clinicians to reduce perioperative risk in high risk patients.. In upper abdominal surgery, there is a larger alteration in pulmonary functions. This study was performed in 30 patients scheduled for laparoscopic cholecystectomy and for upper abdominal open cholecystectomy. The study revealed that after both laparoscopic & open upper abdominal cholecystectomy there was significant alteration of pulmonary function. There was significant alteration at six hours and after operation which then gradually improved, but it took about 24 hours for its complete recovery. The alteration was more evident in open cholycystectomy. Nevertheless these alterations did not cause any clinical derangement as expressed by SpO_2, HR, & BP. The study also showed a significant dose reduction of opioid in case of laparoscopic cholecystomy. The lung function at postoperative ward correlated well with the level of analgesia. But persistent alteration of pulmonary function indicated presence of other mechanical factors.

Key Wards*: Surgery-Lap.Cholecystectomy, Surgery-Upper abdominal, Complication-post- Operative, complication-pulmonary, Patient control analgesia*

INTRODUCTION:

Pulmonary Function Tests (PFTs) refer to measurement of a patient's airflow (spirometry), lung volumes and alveolar diffusing capacity. The values vary according to age, height and gender[1,2]. The procedure related postoperative pulmonary complications depend on the site and size of surgical trauma[3]. The risk of postoperative pulmonary complications increase as the incision approaches the diaphragm and when the duration of surgery exceeds 3 hours[3]. In upper abdominal and thoracic surgery, the postoperative pulmonary complications ranged between 10% to 40%[3]. The patients with previously normal lungs suffered impairment of oxygenation for 48 hours after abdominal surgery[3].

Impairment of oxygenation in the postoperative period is related to reduction in FRC. After induction of anesthesia, there is an abrupt decrease in FRC. At postoperative ward, FRC is further deteriorated by wound pain which causes spasm of the respiratory muscles. The supine position also reduces FRC. The reduction in FRC may lead to closing capacity impinging upon the tidal breathing range. This results closure of small airway during normal tidal ventilation. Gas trapping occurs in the affected airways and subsequent absorption of air may lead to the development of small, discrete areas of atelectasis, which are not visible on chest X-Ray. This occurs mainly in the dependent parts of the lung[1].

Open cholecystectomy performed either by sub costal or midline incision might be associated with significant alterations in pulmonary functions. A restrictive breathing pattern with reduced inspiratory capacity is evident immediately after surgery[4]. A shift from abdominal to thoracic breathing occurs because of the reduced

1. Registrar, Department of Anaesthesia and Intensive Care Unit, Apollo Hospitals Dhaka
2. Associate Professor, Dept. of Anaesthesia, Analgesia and Intensive Care Medicine, BSMMU
3. Consultant, Department of Anaesthesia and Intensive Care Unit, Apollo Hospitals Dhaka
4. Consultant-in charge, Dept. of Anaesthesia, Analgesia and Intensive Care Medicine, BSMMU

diaphragmatic contribution to tidal volume[5]. Although the etiology of pulmonary dysfunction after upper abdominal surgery is not completely elucidated but the post operative pain and diaphragmatic dysfunctions are considered to be the major contributing factors[5,6,7].

Laparoscopic surgery is considered as a day case surgery where patients are allowed to go home in the same day or on the next day. The procedure is associated with the multiple puncture of abdominal wall and distension abdominal cavity with CO_2.

This study was designed to compare post-operative pulmonary function after open cholecystectomy with laparoscopic cholecystectomy.

METHODOLOGY

Thirty patients of ASA grade -I and II scheduled for cholecystectomy were included in this study. Patients with any acute chest disease e.g. infection, atelectasis, emphysema, sepsis or any systemic diseases, cardiac and renal failure, patients with chest deformity, extremely old patient and heavy smokers were excluded from the study.

Patients were divided into two groups. Group-A (n=15) = Patient scheduled for laparoscopic cholecystectomy. Group-B (n=15) = Patient scheduled for open cholecystectomy.

The patients were explained the purpose of the study, Spirometric procedure to measure lung function, use of Patient Controlled Analgesia (PCA) device. They were also explained about Visual Analogue Scale (VAS) and Verbal Rating Score (VRS) to assess pain during postoperative period.

In the pre-anaesthetic check up room, haemodynamic status as indicated by heart rate, systolic and diastolic blood pressures were measured. PFTs were also measured by using Spiro meter and the results were recorded.

On the operation table, haemodynamic status was again recorded. After pre-medication with Fentanyl 2μg/kg, anaesthesia was induced with thiopental sodium 3-5 mg/kg. The suxamethonium 1.5 mg/kg was given to facilitate endo-tracheal intubation. Then neuromuscular block was maintained with vecuronium 0.01mg/kg. The anaesthesia was maintained by 70% N_2O in O_2 along with fentanyl given intermittently in every 30 minutes. Half an hour before extubation, ketorolac 0.5mg/kg were given to each patient. At the end of anaesthesia, residual neuromuscular block was antagonized using neostigmine 0.05mg/kg with atropine. The haemodynamic parameters were again recorded.

In the postoperative ward, haemodynamic status were recorded at 10 min. 6 hours & 24 hours operation. The patient controlled analgesia (PCA) device was started immediately after operation. A loading dose of pethidine 0.5mg/kg was given and PCA dose of 10mg with 20 minutes lockout time and 4 hours limiting dose of pethidine 10mg. was fixed. VAS and VRS were recorded immediately after operation & at 1 hour, 6 hours, 12 hour and at 24 hours in the post operative ward. Spirometric pulmonary function expressed as FVC and FEV_1 were recorded at 6 hours and at 24 hours post-operatively. The data was collected in prescribed form and analyzed by student's "t" test and $p<0.05$ was considered as significant.

RESULTS:

The demographic data of the two groups were statistically matched age, sex, body weight and height (Table-1).

Table -I

Patient characteristics of the two groups

Parameter	Group A (n=15)	Group B (n=15)
Age (years)	34.87 ±2.11	42.00 ±2.86
Weight (kg)	56.73 ±2.89	47.40 ±1.99
Height (m)	1.44.20 ±1.28	152.93 ±2.08
Sex Male	2 (13%)	11 (70%)
Female	13 (87%)	4 (27%)

Values are expressed as Mean ± SEM.

*p<0.05 (Student's t test).

In Group-A, the FEV_1 measured preoperatively and at 6 & 24 hours after operation, declined significantly ($p < 0.01$) in comparison to preoperative value. At 6 hours, the decline was significant but between 6 to 24 hours, the decline was not statistically significant. Quantitatively the FEV_1 was decreased to 13% at 6 hours and 10% at 24 hours in comparison with preoperative value. The result showed that the most significant alteration was at six hours. There after recovery of PFT was gradual which failed to come at base line even after 24 hours. In Group-B, FEV_1 of the subjects measured preoperatively and at 6 hours and 24 hours in postoperative periods, declined significantly ($p <$

1.01). Quantitatively there was 15% decrease of FEV_1 at 6 hours and 13% decrease at 24 hours in comparison to preoperative value (Fig.-1).

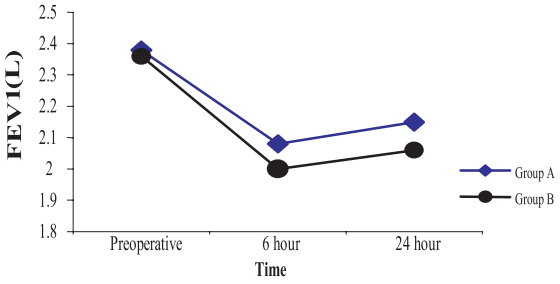

Fig 1. *Changes of Forced Expiratory Volume in 1st second (FEV_1)*

Regarding FVC in both groups, there were similar changes like FEV_1. Again the difference between groups are not significant (Figure-2).

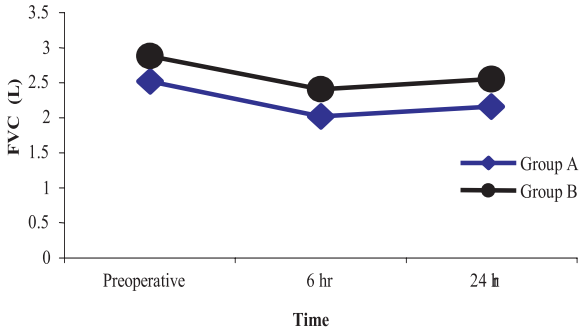

Fig. 2: *Changes in Forced Vital Capacity (FVC)*

The Assessment of pain with Visual Analogue Scale (VAS) and with Visual Rating Scale (VRS) are shown in Table – III & IV which is significantly higher in Group-B than that of Group-A (P <0.001).

Table-II

Haemodynamic values in two groups

Observation	Group A (LC) (n=15)			Group B (OC) (n=15)		
	HR (beats/min)	SBP (mm Hg)	DBP (mm Hg)	HR (beats/min)	SBP (mm Hg)	DBP (mm Hg)
Preoperative	75.33+1.68	121+2.36	71+1.96	78.40+2.21	109+3.53	66+2.66
At extubation	87.00+2.22	125+2.68	80+2.12	83.46+1.81	119+2.41	75+2.13
10 min	80.93+2.01	122+2.53	73+1.27	82.20+2.16	117+2.71	73+1.42
6 hour	73.40+1.22	113+1.58	71+1.58	79.40+0.97	111+2.04	72+2.00
24 hour	75.60+1.39	112+1.41	73+1.05	76.66+1.06	110+1.69	71+1.14

Values are expressed as Mean ± SEM; *P<0.05 (student's 't' test)
SPO_2 of the two groups was similar and maintained at the optimum level.

The Haemodynamic changes were not statistically significant though systolic blood pressure was higher in Group-A than that of Group-B (Table-II).

Table-III

Visual Analogue Scale Pain scores(VAS)

Observation (n = 30)	Group A(LC) (n=15)	Group B(OC) (n=15)
Immediate postoperative (t1)	0.2667 ± 0.1817	1.2000 ± 0.2619
1 hour (t2)	0.4667 ± 0.2153	1.2000 ± 0.2619
6 hour (t3)	0.6000 ± 0.2350	1.2667 ± 0.3446
12 hour (t4)	0.2667 ± 0.1817	1.5333 ± 0.2557
24 hour (t5)	0.0000 ± 0.0000	1.4667 ± 0.2153

Mean ± SEM; *P <0.05 (Student's t test)

Table-IV

Verbal Rating Scale Pain scores(VRS)

Observation (n = 30)	Group A(LC) (n=15)	Group B(OC) (n=15)
Immediate postoperative (t1)	0.0670±0.0660	0.7333±0.1182
1 hour (t2)	0.2000±0.1069	0.5333±0.1333
6 hour (t3)	0.3333±0.1260	0.6000±0.1309
12 hour (t4	0.2000±0.1069	0.7333±0.1182
24 hour (t5)	0.0000±0.0000	1.0000±0.0000

Mean ± SEM; *P <0.05 (Student's t test)

Total dose of opioid used in Group-A were 52.6667 ± 2.6216 mg and in Group -B were 96.8000 + 3.4972 /mg. The difference is statistically significant (P <0.05).

DISCUSSION

The present study showed that the lung functions declined significantly in the postoperative period ($P < 0.01$) in group A in comparison to preoperative value. The maximum decline was at 6 hours after operation. This result was similar to the study of Koba[8]. In group B, the lung function tests also declined ($P<1.01$) significantly. At 6 hours after operation there was statistically significant alteration in comparison to preoperative value ($P < 1.01$).

Results obtained from this study indicated that there was considerable impairment of pulmonary function after laparoscopic cholecystectomy even in healthy patients. The patterns of postoperative alterations were qualitatively similar but quantitatively less than those in open cholecystectomy. In previous observation[9, 10] and non-randomized controlled[4, 11-15] studies, the post operative reduction in FVC, FEV_1 and $FEF_{25\%-75\%}$ ranged from 20% to 40% on the 1st and 2nd post operative day after laparoscopic cholecystectomy and from 40% to 70% after open cholecystectomy in healthy patients. Similar pattern of changes in pulmonary function after laparoscopic and open cholecystectomy was also observed in our study. The small discrepancies may possibly be related to differences in patient selection criteria, duration of anaesthesia and surgery and measurement of different post operative times. However, the most important finding is that laparoscopic cholecystectomy was associated with less impairment of pulmonary function (FEV_1, FVC AND VC) compared with open chocystectomy.

Pain score and analgesic requirement in this study was collected up to 2nd post operative period. This was because most of the patients undergoing laparoscopic Cholecystectomy were discharged from hospital at that time. Decreased pain score and reduced analgesic requirements observed during this period confirmed the clinical observation that laparoscopic cholecystectomy was accompanied by less post operative pain. However, it is not evident if less post operative pain is the only factor responsible for less impairment in pulmonary function after laparoscopic cholecystectomy. The use of opioid analgesic via PCA instrument provided adequate pain relief.

In other studies[16] ABG and post operative atelectasis was also observed which was not done in our study. TLC and RV were also done in the same study[16] which was again not possible in our study due to lack of facilities.

Post-operative alteration in pulmonary function is clinically important if they contribute to respiratory complications. The decrease in FRC has been shown to be correlated well with post operative atelectasis and hypoxemia. Though atelectasis was not excluded in our study but changes of S_PO_2 was observed during the whole time of study which correlate with other observation[16]. Better oxygenation after laparoscopic cholecystectomy compared with open cholecystectomy has been also reported by other authors[11, 13, and 14].

However a extensive study involving a larger group and also measuring other parameters such as ABG(Arterial Blood Gas) and X-ray chest may be under taken to find out whether the patients under going upper abdominal open surgery got any CO_2 retention which might have any reflection over lung function alteration.

In conclusion, it is observed that preoperative PFTs may be influenced by the selection of patients, may be modifed by the approach of the anesthetist. It is also indicated that the need for prophylactic measures preoperatively and in the early postoperative period and may act as an indicator to determine the patients street fitness to go home in respect to their pulmonary function. The study also recommends for optimum pain relief in the post-operative period in an effort to maintain optimum pulmonary function.

REFERENCES

1. Theresa L, et al. Pulmonary Function testing and interpretation. In: Duke EJ. Anesthesia secrets. 2nd Edition. 2001. 429-433.
2. Morgan GE, Mikhail MS. Respiratory Physiology & anesthesia. In: Clinical Anesthesiology, Third edition. Lange Medical book / McGraw- Hill 2002; 167, 248- 49, 475-500.
3. Stoelting RK, Dierdorf SF. Chronic obstructive pulmonary disease. In: Anesthesia and Co-existing Disease, 4th Edition. Churchill Livingstone, 2002; 182-183.

4. Frazee RC, et al. Open verses laparoscopic cholecystectomy: a comparison of Postoperative pulmonary function .Annals of Surgery 1991; 213: 651-654.

5. Mankinian B, et al. Improvement of diaphragmatic function by a thoracic extradural block after upper abdominal surgery. Anaesthesiology 1988; 68: 379-386.

6. Brismar B, et al. Postoperative analgesia with intraplural administration of Bupivacaine and adrenaline. Acta Chirurgica Scandinavica1987; 31: 515-520.

7. Wahba WW, et al. post operative epidural analgesia: effect of lung volumes. Canadian Anaesthetist society Journal 1975; 22: 519-527.

8. Joris J, Kaba A, Larry M. Postoperative Spirometry after laparoscopy for lower or upper abdominal surgical procedures. Br. J Anaes, 1997; 79: 422-426

9. Freeman JA, Armstrong IR. Pulmonary tests before and after laparoscopic Cholecystectomy. Anaesthesia 1994; 49: 579-582.

10. Johnson D, et al. Postoperative respiratory function after lapaaroscopic cholecystectomy. Surgical Laparoscopy and Endoscope 1992; 2: 221-226.

11. Mealy J. Physiological and metabolic responses to open and lap. Cholacystectomy. British Journal of surgery 1992; 79: 1061-1062.

12. Rademaker BM, et al. Pulmonary function and stress response after laparoscopic cholecystectomy; comparison with subtotal incision and influence of thoracic epidural. Analgesia 1992; 75: 381-385.

13. Joris J et al. Metabolic and respiratory changes after cholecystectomy performed via laparotomy or laparoscopy. British Journal of anaesthesia 1992; 69: 341-345.

14. Putensen-Himmer G, et al. Comparison of postoperative respiratory function after laparoscopic or open laparotomy for cholecystectomy. Anaesthesiology 1992; 77: 675-680.

15. Schauer PR, et al. Pulmonary function after laparoscopic cholacystectomy. Surgery 1993; 114: 389-399.

16. Karayiannakis AJ, et al. Postoperative pulmonary function after laparoscopic and open cholecystectomy.British Journal of Anaesthesia 1996; 77: 448-452.