CHAPTER 1

INTRODUCTION
1.1 General Introduction

Chest physiotherapy is a common practice in patients undergoing cardio-thoracic and abdominal surgery.\textsuperscript{1} Abdominal surgery that was previously performed via a large incision is now more commonly performed laparoscopically.\textsuperscript{2} The laparoscopic surgeries involve structures such as the gall bladder, colon, small intestine, stomach, liver and pancreas.\textsuperscript{1}

1.2 Lung Function in Laparoscopy

In laparoscopy, intra-operative pulmonary changes are due to decreased pulmonary compliance secondary to upward movement of the diaphragm during insufflation and to changes in carboxydiode (CO\textsubscript{2}) homeostasis secondary to absorption of insufflated CO\textsubscript{2} from peritoneum.\textsuperscript{3} General anesthesia and surgery related pain may lead to changes in the ventilation pattern resulting in the patient taking shallow breaths which reduce the ability to clear sputum from the chest.\textsuperscript{4-6}

1.3 Postoperative Pulmonary Dysfunction in Laparoscopy

Studies have reported altered pulmonary function after both conventional and laparoscopic abdominal surgeries.\textsuperscript{7-12} Post-operative pulmonary dysfunction in laparoscopic surgery is approximately 20\% to 25\% depending upon the type of surgery.\textsuperscript{7-9} Pulmonary dysfunction leads to pulmonary complication (s) which includes atelectasis, pneumonia, tracheo-bronchial infection and respiratory failure. These may have an adverse effect on the length of hospital stay.\textsuperscript{4}
Reduction of pulmonary function, Forced Vital Capacity (FVC) and Forced Expiratory Vital Capacity (FEV\textsubscript{1}) have been reported on the basis of functional alterations.\textsuperscript{10} Pathogenesis of postoperative pulmonary dysfunction has been attributed to diaphragmatic function impairment.\textsuperscript{13,14}

1.4 Chest Physiotherapy

Chest physiotherapy has been employed as an alternative intervention to reduce occurrence of pulmonary function loss and its complications. Post-operative chest physiotherapy started being implemented in the beginning of the 20th century. It includes breathing exercises, percussion, vibration, splinted huffing/ coughing, positioning and mobilization.\textsuperscript{15}

1.5 Diaphragmatic Breathing Exercise

Diaphragmatic breathing exercises are used in order to augment diaphragmatic descent while inhalation and diaphragmatic ascent while expiration. The beneficial effects of diaphragmatic breathing are as follows: inflation of the alveoli, reversing postoperative hypoxemia, improvement of ventilation and oxygenation, decreasing the work of breathing and increase the degree of excursion of the diaphragm.\textsuperscript{16,17}

1.6 Incentive Spirometry

Mechanical breathing device such as the Incentive Spirometry (IS) has been introduced into clinical practice. Incentive spirometry encourages the patient to take long, slow deep breath mimicking natural sighing and also provides a visual positive feedback. Incentive spirometers are available either by volume of inspiration (volume-oriented) or flow rate (flow-oriented).\textsuperscript{4-6,18-20}
1.7 Flow and Volume Incentive Spirometry

The flow-oriented incentive spirometer (Triflow device) consists of three chambers in series, each of which contains a ball. When the patient’s effort generates a subatmosphere pressure above the ball, it rises in the chamber. An inspiratory flow of 600mL/s is required to raise the first ball, an inspiratory flow of 900 mL/s is required to elevate the first and second balls, and a flow of 1200 mL/s is required to elevate all three balls. The volume-oriented incentive spirometer is a compact device of 4000 ml capacity and has a one-way valve to prevent exhalation into the unit. A sliding pointer indicates the prescribed inspiratory volume and an inspiratory flow guide coaches the subject to inhale slowly.18-20

Studies suggest a physiologically significant difference in the effect of the flow and volume-oriented incentive spirometer. Flow-oriented devices (Triflow device) enforce more work of breathing and increase muscular activity of the upper chest. Volume-oriented devices (Coach 2 device) enforce less work of breathing and improve diaphragmatic activity.6, 18-21

Earlier studies show that the volumetric incentive spirometer is better in case of cardiac and thoracic surgeries because it provides the appropriate feedback for a slow sustained inspiration and volume.18 Studies show that slow sustained inspirations are much more effective to promote lung expansion rather than fast inspirations.18 Studies also show that diaphragmatic breathing exercise encourages more diaphragmatic movement. 17, 18
Gastaldi AC et al concluded that in patients who had undergone laparoscopic cholecystectomy, muscle strength and pulmonary function showed an early recovery with chest physiotherapy. Ashraf A E et al showed that aerobic exercises and incentive spirometry were associated with less postoperative pulmonary complications after laparoscopic cholecystectomy. Kundra P et al concluded that the better preservation of lung function was observed with pre-operative rather than post-operative incentive spirometry.

1.8 Need for the Study

Various chest physiotherapy techniques are used clinically as part of the routine prophylactic and therapeutic regimen in post-operative respiratory care. However, the efficacy of flow- and volume- incentive spirometry and diaphragmatic breathing exercise is still in controversy.

There are no retrievable studies that have been done on the clinical efficacy of diaphragmatic breathing exercise and flow and volume-incentive spirometry after laparoscopic abdominal surgery. With this background the present study is planned to compare the effect of diaphragmatic breathing exercise, flow and volume-incentive spirometry on pulmonary function and diaphragm excursion, following laparoscopic surgery.

1.9 Purpose of the Study

To compare the three different breathing exercises on pulmonary function and diaphragm excursion in patients undergoing laparoscopic surgery.
1.10 Objective of the Study

The effect of diaphragmatic breathing exercise, flow-oriented and volume-oriented incentive spirometry on pulmonary function and diaphragm excursion in patients undergoing laparoscopic procedure.

1.11 Null hypothesis

There will be no difference in the effects of diaphragmatic breathing exercise, volume and flow-oriented incentive spirometry on pulmonary function and diaphragm excursion in patients undergoing laparoscopic abdominal surgery.