International Journal of Physical Education, Sports and Health 2018; 5(3): 95-98

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2018; 5(3): 95-98

www.kheljournal.com
Received: 18-03-2018
Accepted: 19-04-2018

Sudhakara PM
Tutor, Kempegowda Institute of Physiotherapy, KR. Road, VV. Pura, Bangalore, Karnataka, India

Hamsalekha MC
Physiotherapist, Deic, Vani Vilas Hospital, Bangalore, Karnataka, India

Correspondence
Sudhakara PM
Tutor, Kempegowda Institute of Physiotherapy, KR. Road, VV. Pura, Bangalore, Karnataka, India

The effect of deep breathing execerises and incentive spirometer on lung function in subjects following abdominal surgery

Sudhakara PM and Hamsalekha MC

Abstract
Objective: The objective of this study is to find out the effect of deep breathing exercises (DBE) and Incentive spirometer following abdominal surgery on pain and lung function. As post-surgical dysfunction of the respiratory muscles leads to reduction in the vital capacity, tidal volume, total lung capacity and thus insufficient coughs. This may cause atelectasis in the basal lung segments and a decrease in functional residual capacity, which in turn leads to ventilation / perfusion (v/q) mismatch.
Methodology: 40 patients following abdominal surgery was selected from Kempegowda Institute of Medical Sciences and Research Institute. Routine chest physiotherapy and deep breathing exercises and Incentive spirometer was used following, Peak expiratory flow rate and thoracic excursion measurements and VAS score of all the subjects were recorded on 1st, 5th and 7th post-operative day.
Result: Results of the study showed statistically significant improvement ($p<0.001$) in PEFR and Thoracic Excursion measurement from 1st to 7th day following the intervention.
Conclusion: The significant improvement in PEFR and Thoracic excursion measurements observed in the subjects showed that deep breathing exercises and Incentive spirometer is effective in physical therapy intervention to reduce pain and improve lung volumes due to increased neurological arousal and a greater stimulus to deeper breath.

Keywords: Atelectasis, deep breathing exercises, incentive spirometer, peak expiratory flow rate, thoracic excursion measurement

1. Introduction
More than 4 million abdominal surgeries are performed in India every year. Patients undergoing abdominal surgery are at increased risk for pulmonary complications postoperatively with increased morbidity, mortality and hospital length of stay.[1] Post-operative pulmonary complications were identified as early as 1910 by Pasteur, who thought it was due to a failure of respiratory power.[2]
Abdominal surgical procedures are associated with a high incidence of postoperative pulmonary complications which are defined as "pulmonary abnormalities occurring in the postoperative period producing clinically significant identifiable disease or dysfunction that adversely affects the clinical course". Pulmonary complications following abdominal and chest surgery have a relatively higher incidence rate when compared to surgeries performed on other parts of the body. The main reason for this is a severe and prolonged alteration in the pulmonary mechanics caused by these surgical incisions; thereby causing impaired ventilation and ineffective expectoration. This results in failure in expansion and collapse of the particular lung segment, thus providing an excellent chance for chest infection [3]. Postoperative complication following upper abdominal surgery reported in the literature is 20%-30%. The incidence of atelectasis ranges from 20% to 69% and for the post-operative pneumonia from 9% to 40% [4].
The manipulation of abdominal cavity during abdominal surgery decreases lung volume and capacity. This leads to shallow and rapid breathing, absence of deep breaths and paradoxical abdominal movements, which may cause pulmonary complications with altered ventilation-perfusion or pulmonary shunts that result in hypoxemia and atelectasis [5]. As there is an increased need for alveolar ventilation due to the shunt induced by carbon dioxide retention,

the work of breathing increases, the abdominal wall stiffens and there is a possible diaphragmatic dysfunction. Severe postoperative pain is another factor that limits pulmonary function and depending on severity it may contribute to a higher morbidity and mortality [6].

Following surgery, it is believed that mucociliary clearance is adversely affected due to effects of general anesthesia, intubation and pharmacological agents such as narcotic analgesics used in the preoperative period. Reduced ability to cough effectively due to pain and mechanical disruption of the major expiratory muscles with a decrease in regional ventilation provides a good potential for pulmonary secretion formation [7].

Peak expiratory flow rate is an objective measure of airflow resistance in the lungs. The peak expiratory flow rate is considered as a surrogate for the forced expiratory volume in 1 second (FEV1).

The rationale for use of thoracic expansion measurement is the range of motion of thorax, including the thoracic vertebrae, sternum and ribs, which serves the respiration.

2. Materials and methods

The purpose of the study was to evaluate the effect of deep breathing exercises and incentive spirometer on the lung function in post abdominal surgery subjects. To achieve this 40 subjects were selected by purposive sampling at Kempegowda Institute of Medical Science and Research Centre, Bangalore.

All the 40 subjects were given routine chest physiotherapy and deep breathing exercises and Incentive spirometer.

Peak expiratory flow rate and thoracic excursion measurements and VAS score of all the subjects were used as the outcome measure on 1st, 5th and 7th post-operative day.

2.1 Intervention

Incentive spirometer: Subjects will be positioned comfortably. Subjects will be instructed to exhale by letting all the breath out and then to close the lips around mouthpiece of the spirometer and inhale slowly. Subjects will ask to hold the breath for 2-3 seconds then exhale slowly. This process should repeat 10 times each hour while the subject is awake.

Deep breathing exercises patients had large, significant increases in tidal volume (mean change 488.5mL), while respiratory rate decreased non-significantly. Place one hand on your belly, just below your ribs. Place the other hand on your chest, Take a regular breath now takes a slow, deep breath. Breathe in slowly through your nose. Pay attention as your belly swells up under your hand, Holding your breath, pause for a second or two, slowly breathe out through your mouth. Pay attention as the hand on your belly goes in with the breath.

2.2 Outcome measures

Thoracic excursion Measurement: The purpose and technique was explained to the subjects. The part to be assessed is exposed for taking measurements. Having the patient positioned comfortably circumferential measurements will be taken at two levels, That is – Upper thoracic level and Lower thoracic level.

For upper thoracic region the point on the fifth spinous process at the back and third inter costal space at the mid clavicle line at front was taken. For lower thoracic region, the point on the tenth thoracic spinous process and the tip of the xiphoid process was considered. Marker pen is used for marking the reference point for tape placement.

Readings were taken by keeping measure tape flat against subject's skin at the end of full inspiration and expiration. The tape was held snugly but not tightly, so the contour of soft tissue remained unchanged. Three measurements were taken for each subject from 1st, 5th and 7th post-op day

Peak expiratory flow rate (PEFR) is an objective measure of airflow resistance in the lungs. PEFR is the largest expiratory flow achieved with a maximally forced effort from a position of maximal inspiration. The peak expiratory flow rate is considered as a surrogate for the forced expiratory volume in 1 second (FEV1). The pointer is checked for zero. The mouthpiece of the peak flow rate meter is placed in the patient's mouth and sealed by the lips. The tongue should not be placed in the front opening of the meter. Peak expiratory flow meter is held horizontal and patient is asked to take a deep breath and blow, short, sharp and hard as possible. These steps were repeated 3 times. The mean of 3 values is taken for the study.

Visual Analog Scale (VAS) is a widely used pain rating scale which consist of a horizontal line of 10cms where intensity of pain perceived by patient is been asked to mark over it. This was used as a subjective measure of the post-operative pain by the subjects.

3. Results & Discussion

Following the study conducted to evaluate the effect of Deep breathing exercise and Incentive spirometer on lung function in subjects following abdominal surgeries, results of the study showed that there is significant improvement in PEFR and Thoracic excursion measurement in a group of 40 subjects in comparison between the 1st, 5th and 7th postoperative day.

Reduction in the lung mechanic test parameters (FVC, FEV1 and PEF) maybe due to general anaesthesia, the site and the length of the incision, postoperative pain which causes splinting of the ribs and the diaphragm, and diaphragmatic dysfunction. Reduction in the efficiency of the respiratory muscles will reduce the chest expansion. PEFR recorded in the study is considered as a surrogate for the forced expiratory volume in 1 second.

At the 7th postoperative day results showed significant (p<0.001) improvement in mean value of PEFR of 288.22lts /min with SD 51.05, compared with mean value of PEFR of 248.37lts/min with SD 47.10 and 211.6lts/min and SD 49.44 on the 1nd and 5th postoperative day respectively. There is gradual improvement shown from the 1st post op day to the 7th post op day which is also statistically significant.

Thoracic excursion was measured using the inch tape to measure chest expansion both at upper and lower thoracic level. Thoracic excursion measurements taken showed significant (p<0.001) improvement in 7th postoperative day in comparison with the 5thand 1st postoperative day, for both the upper thoracic excursion and lower thoracic excursion.

For upper thoracic excursion measurement with mean of 4.49cms with SD 0.68 on 7th postoperative day, while 3.41cms with SD 0.76 on 5th postoperative day and.2.24 cms with SD 0.61 on 1st post op day.

Lower Thoracic excursion measurements also showed significant (p<0.001) improvement with the mean of 3.81cms with SD 0.31 on 7th postoperative day, while 3.08cms with SD 0.59 on 2nd postoperative day and 2.18 and SD 0.48 in 1st post-operative day.

At the 7th postoperative day results showed significant (p<0.001) improvement in mean value of PEFR of 288.22lts /min with SD 51.05, compared with mean value of PEFR of 248.37lts/min with SD 47.10 and 211.6lts/min and SD 49.44

on the 1nd and 5th postoperative day respectively. There is gradual improvement shown from the 1st post op day to the 7th post op day which is also statistically significant.

Thoracic excursion was measured using the inch tape to measure chest expansion both at upper and lower thoracic level. Thoracic excursion measurements taken showed significant (p<0.001) improvement in 7th postoperative day in comparison with the 5thand 1st postoperative day, for both the upper thoracic excursion and lower thoracic excursion.

For upper thoracic excursion measurement with mean of 4.49cms with SD 0.68 on 7th postoperative day, while 3.41cms with SD 0.76 on 5th postoperative day and.2.24 cms with SD 0.61 on 1st post op day.

Pain and trauma of surgical procedures, particularly in Abdominal surgeries, leads to splinting of the ribs and diaphragm, which in turn leads to further collapse of basal lung units. The post-surgical pain in this study was assessed using Visual analog on the 1st and 7th post op day. Decrease in pain perception following treatment with the mean±SD of the score on day 1 was 8.28 ±.64 as compared to 3.45 ±.63 on 7th post op day. The post-surgical pain on the subjects assessed with VAS score showed a statistically significant (P<0.001) decrease in pain.

The results observed in the study has shown that the Deep breathing exercise and incentive spirometer are effective for improving lung function in the immediate post op period following abdominal surgery. This is noted with the significant improvement in PEFR and Thoracic excursion measurements.

An Experimental study of 40 subjects undertaken to find the effect of DBE and Incentive spirometer on PEFR and Thoracic excursion measurement following abdominal surgery.

Table 1: Comparative Evaluation of PEFR in Ltr/Min

PEFR(LTS/Min)	Mean	SD	Mauchlys Chi-Squre Value	P VALUE	Greenhouse-Geisser	P VALUE
1st Post op day	211.60	49.44	47.51	.000	133.78	.000 (<0.001)
1st Post op day	248.38	47.10				
1st Post op day	288.23	51.05				

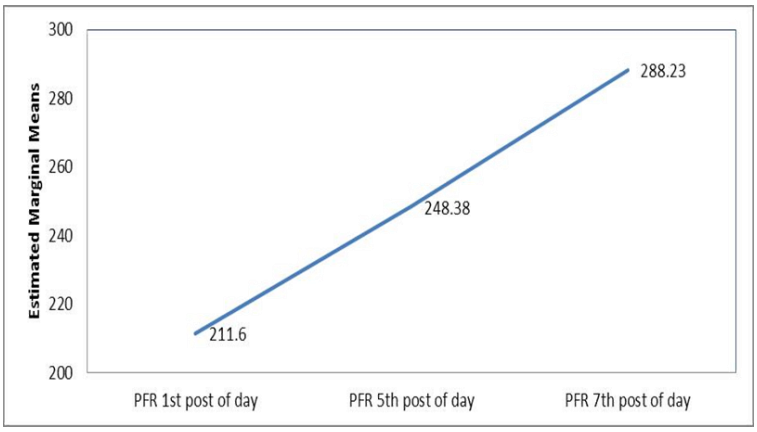

Fig 1: The scores assessed on patient with effect of DBE and Incentive spirometer using PEFR had a significant effect (F=133.78.P<0.001).The mean±SD of the score on day 1 was 211.60 ±49.44 as compared to 248.38 ±47.10 and 288.23 ±51.05 on 5th and 7th post op day respectively (fig 1).there was a gradual increase in the PEFR readings from the 1st post op day to the 7th post op day (fig1)

Table 2: Comparative Evaluation of Upper Thoracic Excursion Measurement

Upper thoracic excursion measurement	Mean	SD	Mauchlys Chi-Squre Value	P VALUE	Greenhouse-Geisser	P VALUE
1st Post op day	2.24	.61	.698	.705	519.78	.000
1st Post op day	3.41	.76				
1st Post op day	4.49	.68				

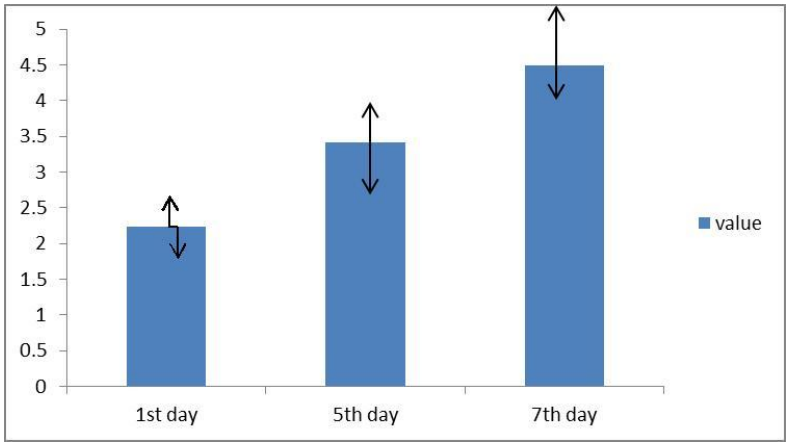

Fig 2: The scores assessed on patient with effect of DBE and Incentive spirometer by using. Upper thoracic excursion measurement had a significant effect (F=519.78.P<0.001).The mean±SD of the score on day 1 was 2.24 ±.61 as compared to 3.41 ±.76 and 4.49 ±.68 on 5th and 7th post op day respectively Shown in figure2.

Table 3: Comparative Evaluation of Lower Thoracic Excursion Measurement

Lower thoracic excursion Measurement	Mean	SD	Mauchlys Chi-Squre Value	P Value	Greenhouse- Geisser	P Value
1st post op day	2.12	.48				
5th post op day	3.08	.59	.996	.608	299.74	.000
7th post op day	3.81	.31				

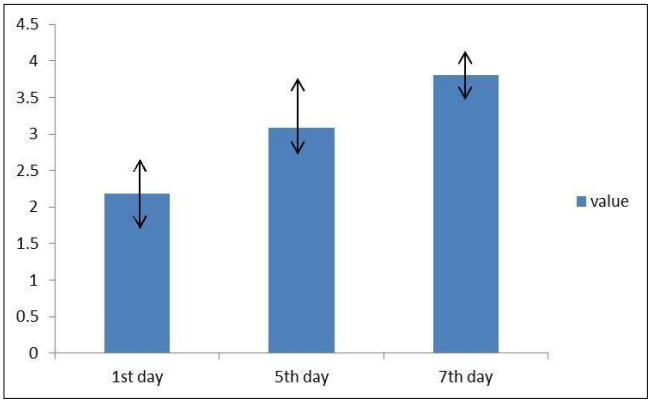

Fig 3: The scores assessed on patient with by effect of DBE and Incentive spirometer by using Lower thoracic excursion measurement had a significant effect (F=299.74.*P*<0.001).The mean SD of the score on day 1 was 2.12 ±.48 as compared to 3.08 ±.59 and 3.81 ±.31 on 5th and 7th post op day respectively

Table 4: Comparative Evaluation of Vas

VAS Scale	Mean	SD	P value
1st post op day	8.28	.64	.000
7st post op day	3.45	.63	

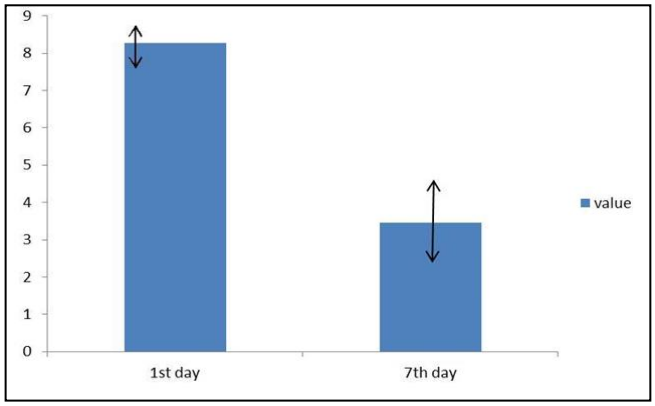

Fig 4: The scores assessed on patient with effect of DBE and Incentive spirometer on VAS scale by using paired sample test had a significant effect (*P*<0.001).The mean±SD of the score on day 1 was 8.28 ±.64 as compared to 3.45 ±.63 on 7th post op day, shown in figure 4.

4. Conclusion

Incentive spirometers, also known as sustained maximal inspiration devices, are used to promote deep breathing thus enhance pulmonary ventilation, overcome the effects of anesthesia or hypoventilation, loosen respiratory secretions, assist respiratory gaseous exchange, and help with re-expansion of collapsed alveoli in this way they help to avoid compromised inspiration and reduced tidal volume. They are also valuable in providing patients with visual feedback of their respiratory effort.

The use of diaphragmatic breathing is commonly practiced, especially in those patients with chronic obstructive pulmonary disease to improve a variety of factors such as pulmonary function, cardio respiratory fitness, respiratory muscle length, and respiratory muscle strength. Specifically, diaphragmatic breathing exercise is essential to asthmatics since breathing in these patients is of the thoracic type in association with decreased chest expansion and chest deformity as a result of a deformed sternum like pectus excavatum (funnel chest) a shortened diaphragm, intercostals and accessory muscles from prolonged spasm causing stenosis of the major airways leading to an abnormal respiratory pattern

The results observed in the subjects included in the study following abdominal surgery showed that DBE and Incentive spirometer is effective in physical therapy intervention to reduce pain and improve lung volumes. The physical therapy interventions like DBE and Incentive spirometer increases neurological arousal and greater stimulus to breath is observed. Following intervention with DBE and Incentive spirometer it allows more effective secretion clearance, which may be especially useful for those patients demonstrating sub-optimal coughing or huffing. This is noted with the significant improvement in PEFR and Thoracic excursion measurements taken following the study.

The study has emphasised that DBE and incentive spirometer are effective for decreasing pain and improving lung function in the immediate post op period following upper abdominal surgery. This is noted with the significant improvement in PEFR and Thoracic excursion measurements.

5. Reference

1. Jo Ann Brooks-Brunn. Predictors of postoperative pulmonary complications following abdominal surgery. Chest. 1997; 111:564-71.
2. Pasteur W: Active lobar collapse of the lung. Lancet. 1910, 1080-1083.
3. Patrick Pasquina, Matin R, Tramer, Jean max Granier and Bernhard Walder. Respiratory physiotherapy to prevent pulmonary complications after abdominal surgery. Chest. 2006; 130:1887-99.
4. Bourn J, Jenkins S. Postoperative respiratory physiotherapy: Indications for treatment". Physiotherapy. 1992; 78: 80-84.
5. Solange Ribeiro. Ada Clarice Gastaldi, Christiany Fernandes. The effect of respiratory kinesiotherapy in patients undergoing upper abdominal surgery. Einstein. 2008; 6:166-9.
6. Patrick Pasquina, Matin R Tramer, Jean max Granier and Bernhard Walder. Respiratory physiotherapy to prevent pulmonary complications after abdominal surgery. Chest. 2006; 130:1887-99.
7. Ahsan MA, Michelle VC, Valerie AL. Preoperative evaluation of postoperative pulmonarycomplications. Med Clin NA m. 2003; 87:153-173.