Original Article

Effectiveness of the incentive spirometry in preventing post-operative pulmonary complications after laparotomy

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Objective: To determine the effectiveness of incentive spirometry in preventing post- operative pulmonary complications after laparotomy.

Methodology: This randomized control trial was conducted in the Fauji Foundation Hospital Rawalpindi, Pakistan from January 2013 to May 2013 and 42 male and 18 female were included in the study. A total of 60 patients, who had underwent laparotomy were randomly assigned to two groups; control group and experimental group. The control group was given only breathing exercises. The experimental group received incentive spirometry and breathing exercises. Improvement was measured by the value of FEV1/ FVC and BORG scale for the rate of perceived dyspnea. Data was analyzed by SPSS v17.

Results: The incentive spirometry improved BORG scale and FEV1/FVC ratio significantly (P=0.0001, P=0.0001) in experimental group, as compared to the deep breathing exercise in control group (P= 0.907 and P=0.897).

Conclusion: Incentive spirometry was an effective tool in preventing post operative pulmonary complications after laparotomy.(Rawal Med J 2014;39: 274-276).

Keywords: Post pulmonary complications, incentive spirometry, breathing exercises.

INTRODUCTION

After any surgery, there are certain changes in the abdominal area, which induce modifications in pulmonary mechanics and respiratory function, resulting in postoperative pulmonary complications.[1] These lead to higher hospital costs, increased morbidity, mortality and extended hospital stay. The changes which lead to these complications include decreased mobility of diaphragm, depressed activity of central nervous system, changes in the ventilation-perfusion ratio, inefficient cough, increased respiratory rate and reduced pulmonary volumes and capacities.[2] Patients who have undergone abdominal surgery show a decline in inspiratory capacity, total inspiratory time, and ventilation at the lung bases, leading to a high risk of developing PPCs.[3,4] Forces acting on the respiratory system help produce the thoracic and abdominal movements, especially the respiratory muscle strength that is compromised after abdominal surgery.[5-7]

Chest physical therapy is commonly requested with the aim to avoid the development of pulmonary complications by reversing the pulmonary dysfunction after laprotomy.[8] Incentive spirometry (IS) is a form of respiratory training that underlines sustained maximum inspirations.[9,10] Incentive spirometry is used primarily to prevent alveolar collapse and atelectasis in postoperative patients. Despite the widespread use of IS for patients after surgery, the effectiveness of this technique alone or in addition to general deep breathing and coughing for the prevention of postoperative pulmonary complications is not clear.[11] This study was undertaken to compare the effects of IS and breathing exercises in preventing or reversing post pulmonary complications after undergoing laparotomy.

METHODOLOGY

This experimental study was conducted in the Fauji Foundation Hospital Rawalpindi, Pakistan from January 2013 to May 2013. Institutional review committee of Riphah International University approved it. A total of 60 patients who had undergone laparotomy were randomly assigned to either experiment group or control group. Sample consists of 42 male and 18 female. The age was 18-70 yrs. Patients with preoperative pulmonary or cardiovascular disease, patients having smoking

history and any other musculoskeletal and neurological disease and those with long ICU stay were excluded from the study.

In control group, the patients were advised to perform breathing exercises including diaphragmatic breathing and active cycle of breathing techniques. In experimental group, they were trained to do IS along with breathing exercises under the supervision of physiotherapist three times a day for 1st and 2nd postoperative day and twice a day for next two days. The total number of attempts of IS was limited to 5 at each session. Structured questionnaire were used to collect data. The scale used for dyspnea was BORG scale for rate of perceived dyspnea. On BORG scale, 0 represent no dyspnea with any activity while 10 represent severe shortness of breath to stop the activity. SPSS 17 was used for data analyses. Paired t test was applied for dyspnea scores and FEV1/ FVC ratio and p value was calculated.

RESULTS

In the experimental group, 7% of patient were experiencing no dyspnea while 20% patient were experiencing moderate SOB, 27% were having mild SOB 46% were experiencing very mild SOB. After receiving treatment 73% patient were dyspnea free while only 3% were experiencing mild dyspnea at discharge.

Table 1. Post operative BORG scale in two groups.

	Experimental group		Control group	
Borg Scale	Borg Scale Day 1	Borg Scale at Day 4	Borg Scale Day 1	Borg Scale at Day 4
0	2	22	4	10
0.5	0	4	10	12
1	14	3	6	7
2	8	1	5	1
3	6	0	3	0
4	-	-	2	0

In the control group 13% patients were having no dyspnea at first post operative day, while 53% were experiencing mild dyspnea, 27% were having moderate dyspnea and 7% were having severe dyspnea. At discharge only 33% patients were dyspnea free, 63% were having mild dyspnea and 3% were having it in moderate form (Table 1).

Table 2. Post operative FEV 1/ FVC ratio (Tiffeneau-Pinelli Index) in two groups.

	Tiffeneau-Pinelli Index in Experimental Group		Tiffeneau-Pinelli Index in Control Group	
T-P Index value	T-P Index at Day 1	T-P Index at Day 4	T-P Index at Day 1	T-P Index at Day 4
<65%	2	0	2	0
<70%	14	3	14	9
<75%	6	7	8	12
80% or more	8	20	6	9

Measurement of FEV1/ FVC ratio showed that 7% patient were having value less than 65%, 47% having it less than 70%, 20% having less than 75%, while only 25% were showing normal value of 80% or more. After receiving IS 67% of the patients were having normal value of 80%, while only 10% of patients were having value below 70% at discharge.

In the control group at the start of treatment only 20% patient were having normal values of FEV1/ FVC while 47% were having value of 70%. At discharge improvement was only 10% as 30% patients were having normal ratios while other 70% patients still had decreased ratios (Table 2).

Table 3. Mean values in experimental group.

		Mean±SD	p
Pair 1	Borg RPD scale Day-1	1.60±0.8944	0.0001
	Borg RPD scale Day-4	0.233±0.4686	
Pair 2	FEV1/FVC Ratio Day-1	1.67±0.959	0.0001
	FEV1/FVC Ratio Day-4	2.57±0.679	

Mean values for Borg RPD scale and FEV1/FVC ratio of experimental group at day 1 and day 4 after treatment were (1.60, .233 & 1.67, 2.57) indicating a significant improvement (Table 3).

DISCUSSION

Post pulmonary complications have been described as pulmonary abnormalities resulting in particular diseases or dysfunctions that are clinically significant and negatively affect the clinical outcome.[11] Insufficient inspiratory effort leading to inadequate expectoration of sputum is a leading cause of postoperative pulmonary complications after abdominal surgery.[12] Our study showed that IS is one of best intervention used for the prevention of post pulmonary complications.

In a study on patients undergoing abdominal surgery, IS was more effective than deep breathing exercises in restoring vital capacity to preoperative

levels.[13] Our study showed that chest expansion increased with IS. In cardiac patients, IS was better for reducing pulmonary complications over intermittent positive-pressure breathing.[14] Significant differences were found in regional expansion of the chest and abdomen during a study and it was suggested that patient using volume oriented IS achieved a larger inspiratory lung volume than did patients subjected to flow oriented IS.[15] In a meta-analysis conducted on patients undergoing abdominal surgery, there was a benefit from the use of breathing exercises and IS.[16]

In patients who had undergone both upper and lower abdominal surgery, IS was preferred because it appeared to shorten the patient's length of stay.[17] One potential limitation of this study was that pre-operative values of FEV1/ FVC ratio were not recorded. A need exists for pre-operative finding of FEV1/FVC ratio to make the study more valid. Sample size of this study was also small, so further study with large sample size is required to explore the benefits of IS.

CONCLUSION

Incentive spirometery was one of the most effective treatment for preventing and treating post pulmonary complications. In order to get better result from the incentive spirometry, it is of crucial value to demonstrate the patient correct technique of using incentive spirometry.

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REFERENCES

1. Warner DO. Preventing postoperative pulmonary complications: the role of the anesthesiologist. Anesthesiology 2000;92:1467-72.
2. Schindler MB. Treatment of atelectasis: where is the evidence? Crit Care 2005;9:341-2.
3. Woodring JH, Reed JC. Types and mechanisms of pulmonary atelectasis. *J Thorac Imaging* 1996;11:92-108.
4. Sharafkhaneh A, Falk JA, Minai OA, Lipson DA. Overview of the perioperative management of lung volume reduction surgery patients. Proc Am Thorac Soc 2008;5:438-41.
5. Manzano RM, Carvalho CR, Saraiva-Romanholo BM, Vieira JE. Chest physiotherapy during immediate postoperative period among patients undergoing upper abdominal surgery: randomized clinical trial. Sao Paulo Med J 2008;126:269-73.
6. Clini E, Ambrosino N. Early physiotherapy in the respiratory intensive care unit. Respir Med 2005;99:1096-1104.
7. Bastin R, Moraine JJ, Bardocsky G, Kahn RJ, Melot C. Incentive spirometry performance. A reliable indicator of pulmonary function in the early postoperative period after lobectomy? Chest 1997;111:559-63.
8. Van de Water JM, Watring WG, Linton LQ. Prevention of postoperative pulmonary complications. Sulg Gynecol Obstet 1972;135:1-5.
9. Roukema J, Carol E, Prins JG. The prevention of pulmonary complications after upper abdominal surgery in patients with noncompromised pulmonary status. Arch Surg 1988;123:30-4.
10. Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. Lancet 2009;373:1874-82.
11. Guimarães MM, El Dib R, Smith AF, Matos D. Incentive spirometry for prevention of postoperative pulmonary complications in upper abdominal surgery. Cochrane Database Syst Rev 2009, 8:CD006058.
12. Bartlett RH, Gazzaniga AB, Geraghty TR. Respiratory maneuvers to prevent postoperative pulmonary complications. A critical review. JAMA 1973; 224:1017-21.
13. Freitas ERFS, Soares BG, Cardoso JR, Atallah AN. Incentive spirometry for preventing pulmonary complications after coronary artery bypass graft. Cochrane Database Syst Rev. 2007; 3:CD004466.
14. Celli BR, Rodriguez KS, Snider GL. A controlled trial of intermittent positive pressure breathing. Incentive spirometry, and deep breathing exercise in preventing pulmonary complications after abdominal surgery. Am Rev Respir Dis 1984;130:12-15.
15. Shu-Chuan HO, Chiang LL, Cheng HF, Lin HC, Sheng Df, KuoHP. The Effect of Incentive Spirometery on Chest Expansion and Breathing Work in Patients with Chronic Obstructive Air way Disease: Comparison of Two Methods. Chang Gung Med J 2000;23:73-9.
16. Overend TJ, Anderson CM, Lucy SD. The effect of incentive spirometry on postoperative pulmonary complications: a systematic review. Chest 2001; 120(3):971-8.
17. Thomas JA, McIntosh JM. Are incentive spirometry, intermittent positive pressure breathing, and deep breathing exercises effective in the prevention of postoperative pulmonary complications after upper abdominal surgery? A systematic overview and meta-analysis. Phys Ther 1994;74:3-1