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Original Research Paper

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STUDY OF EFFECTIVENESS OF INCENTIVE SPIROMETRY ADJUVANT TO DIAPHRAGMATIC BREATHING IN POST ABDOMINAL SURGERY PATIENTS

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ABSTRACT

Abdominal surgeries are performed routinely for the treatment and diagnosis of many diseases [1]. Postoperative pulmonary complications (PPCs) following abdominal surgery are frequent and are responsible for increased morbidity and mortality as well as length of hospital stay and health-related cost of care [2,3]. Common postoperative pulmonary complications include atelectasis, hypoxaemia, pneumonia, respiratory dysfunction and pleural effusion [4,5]. A basic postoperative complication is a lack of lung inflation which results from a change in breathing to a shallow, monotonous pattern without periodic sighs and temporary diaphragmatic dysfunction, caused by prolonged recumbent position, and impaired mucociliary clearance, along with the decreased cough effectiveness secondary to pain which increases the risks associated with retained pulmonary secretions[6]. Incentive spirometry is an inhalation-based prophylactic technique that encourages patients to mimic a natural deep sigh to periodically increase lung volume. As this technique is the prophylactic method of choice for many hospitals, several studies have tested its efficacy.. No single prophylactic technique clearly outperforms all others in preventing pulmonary complications.Hence incentive spirometry along with diaphragmatic exercise is studied to improve the respiratory mechanics in postoperativeperiod in patients who have undergone abdominal surgery.

Incentive Spirometer (IS) which has been introduced into clinical practice by RH Bartlett [7]It is a lung expansion technique designed to induce sighing or yawning by making the patient take long, slow deep breaths. It prevents and treats atelectasis in alert patients who have a predisposition for shallow breathing. It is simple and relatively safe method for doing so Spirometry works by encouraging the patient to achieve a pre-set volume or flow. The volume is determined from predicted values or baseline measurements. [8].Many studies proved it to be an effective device to optimize respiratory functions postoperatively .Fewer studies failed to demonstrate incentive spirometry as an single method to improve respiratory indices and prevent pulmonary complications. Why Have the Studies Been Negative? Poor Methodology is important to point out that poor study methodology complicates the ability to interpret studies of IS efficacy[9] A retrospective analysis is done on the patients who have coperated for incentive spirometry and diaphragmatic exercise against those who denied the IS manoevre .25 patients in each group were studied.Group D comprising of patients who performed only diaphragmatic breathing exercise .Group SD comprising of patients performing incentive spirometry as well as diaphragmatic exercise as per designed protocol. . Results & statistical analysis were performed by using SPSS 10 software. The significance level is set at $p \leq 0.05$.The test of paired sample t-test was used to analyze the data.

Baseline demographic characteristics of the participant's age, gender, height, weight, duration of surgery and anaesthesia and co-morbidities are presented in table 1.Demographic data was found statistically insignificant.

Based on our study results, the pulmonary function { PEFR} after 6 hrs postoperatively although decreased but the difference in both the group is statistically insignificant.On 1st postoperative day patients showed a significant decrease in respiratory indices of both the groups. This is possibly owing to the fact that in the postoperative period there is shallow, monotonous breathing without periodic sighs and prolonged restraint in bed due to postoperative pain, incision site, analgesics, duration of anaesthesia and surgery, all of which decrease the ventilation to dependent lung regions [10].From second day onwards there was significant difference in PEFR values of D and SDgroup.SD group showed improvement in respiratory functions . Although respiratory function improved in both the groups but the magnitude of improvement is more pronounced in SD group.The possible reason for the improvement in pulmonary function in abdominal surgeries could be the use of incentive spirometry, which is a mechanical device used to encourage patients to take long, slow, sustained deep inspirations which leads to achieving maximal inflating pressure in the alveoli and maximal inhaled volume, and also helps to maintain the patency of the smaller airways. Postoperative hypoxaemia is reduced by using incentive spirometry which provides low-level resistance training to the diaphragm and minimizes fatigue thereby improving inspiratory muscle strength and enhancing lung inflation.Early mobilization reduce the incidence of postoperative pulmonary complications hence early mobilization is promoted in both the groups[20]

Conclusion & Recommendations: On the basis of the results Of the Study ,We Strongly Recommend The Following:Both Diaphragmatic Breathing Exercise And Incentive Spirometry Together Can Be Recommended Over Diaphragmatic Breathing Exercise Alone As An Intervention For The Improvement Of Pulmonary Function And Prevention Of Complications In The Patients With Abdominal Surgery

KEYWORDS :

INTRODUCTION:

Respiratory compromise is one of the major drawback in postoperative state of abdominal surgeries. . The patients undergoing abdominal surgery has characteristic post-operative mechanical abnormality in respiration like restrictive pattern of ventilation.[1]Excruciating pain after post anaesthesia effect is troublesome.This pain worsens with deep breathing]. Postoperative pulmonary complications (PPCs) following abdominal surgery are frequent and are responsible for increased morbidity and mortality as well as length of hospital stay and health-related cost of care [2,3]. Common postoperative pulmonary complications include atelectasis, hypoxaemia, pneumonia, respiratory dysfunction and pleural effusion. TheSpontaneous deep breaths to restore functional residual capacity are abolished by pain.2 Incentive Spirometry (IS) promotes frequent maximum inspiratory effort and is used for the prophylaxis and treatment of respiratory complications in postoperative abdominal surgical patients

Conventional breathing technique is used for airway clearance and consists of breath holding, thoracic expansion exercises and huffing. It is known that the functional Residual Capacity and flow rates reduce post operatively however the

effect of breathing technique on improving flow rates has not been extensively studied. Hence the aim was to study the effect of Incentive Spirometry vs conventional deep breathing tecniques on peak flow rates and chest expansion in post-abdominal surgery patients

IS devices are either flow-oriented or volume-oriented. Flow-oriented IS devices consist of a chamber with 3 interconnected columns in which lightweight plastic floats are seated. The chamber is connected to a flexible tube with a mouthpiece through which the patient inhales, attempting to raise the floats through inspiratory flow created by negative intrathoracic pressure. Volume-oriented IS devices consist of a flexible tube with a mouthpiece connected to a chamber that has volume measurements displayed. When the patient inhales, a piston in the chamber rises to the maximum volume of air displaced.

METHOD

It is a retrospective analysis done on the patients who have coperated for incentive spirometry against those who denied the manoevre .Patients were divided into two groups.Group D is comprising of control group where the incentive spirometry was not being done due to various reasons …patients non coperation and financial constraints to purchase the equipment was among the common reason for not conduction of incentive spirometry .In this group patients performed only diaphragmatic breathing.

Method of diaphragmatic breathing conventionally used was as follows:
Patient is lying comfortably, with knees bent and shoulders, head and neck relaxed..Patient place one hand on upper chest and the other just below rib cage. This will allow to feel r diaphragm move as one breathe.Then the patient breathe in slowly through nose so that stomach moves out against hand. .The hand on chest should remain as still as possible. Thereafter patient is asked to tighten stomach muscles, letting them fall inward as he/she exhale through pursed lips. The hand on upper chest must remain as still as possible..During the exercise sutured are supported with hand placed on abdomen.This exercise is done for 5 minutes atleast 6 times in a waking period of patients in a day alternately with incentive spirometry manouvre.

GroupB is comprising of study group where incentive spirometry was used as per protocol.Method of IS patient

Patient sit on the edge of bed if possible, or sit up as far as he can in bed.Holding the incentive spirometer in an upright position he/she place the mouthpiece in mouth and seal the lips tightly around it.Thereafter he/she breathe in slowly and as deeply as possible.

Patient is asked to take 10-15 breaths every1-2 hrly.Minimum of 10 cycles/day to be completed by patients included in SD group

INCLUSION CRITERIA

Age between 28-60 years of all male as well female undergoing exploratory laparatomy with vertical dermal incision.

EXCLUSION CRITERIA:

Patients with unstable hemodynamic parameters (arterial pressure <100 mmHg systolic and <60 mmHg for diastolic and mean arterial pressure (MAP) <80 mmHg).

Patients on mechanical ventilator

Patients with postoperative complications requiring mechanical ventilation.

Uncooperative patients or patients unable to understand or to use the device properly.

Patients with pre- existing pulmonary complications Duration of surgery less than 1hr or more than 3 hrs

OBSERVATION:

Demographic data:

Variables	Mean±SD	Range
Age(yrs)	44±4.49	28-50
Weight(kg)	68±5.11	46-90
Height(cm)	161±3.36	150-172
BMI(KG/M2)	28±2.01	25-31

PEFR values in both the groups:

PEFR VALUES	Group D Mean±SD	Group SD Mean ±SD	P value
6 hrs after surgery	256.54±18.30	242.56+_68.32	0.43
1st day after surgery	196.01±11.34	201.53±18.99	0.38
4th day after surgery	220±16.42	275.21±23.62	0.004
6th day after surgery	236±14.32	294.16±22.18	0.003

DISCUSSION

Postoperative pulmonary complications (PPCs) following abdominal surgery are frequent and are responsible for increased morbidity and mortality as well as length of hospital stay and health-related cost of care [2,3]. Common postoperative pulmonary complications include atelectasis, hypoxaemia, pneumonia, respiratory dysfunction and pleural effusion [4,5]. A basic postoperative complication is a lack of lung inflation which results from a change in breathing to a shallow, monotonous pattern without periodic sighs and temporary diaphragmatic dysfunction, caused by prolonged recumbent position, and impaired mucociliary clearance, along with the decreased cough effectiveness secondary to pain which increases the risks associated with retained pulmonary secretions[6].

Incentive Spirometer (IS) which has been introduced into clinical practice by R H Barlett et al .[7] It is designed to induce sighing or yawning by making the patient take long, slow deep breaths. It prevents and treats atelectasis in alert patients who have a predisposition for shallow breathing. It is simple and relatively safe method for doing so Spirometry works by encouraging the patient to achieve a pre-set volume or flow. The volume is determined from predicted values or baseline measurements. [8].

Many studies proved it to be an effective device to optimize respiratory functions postoperatively .Fewer studies failed to demonstrate incentive spirometry as an single method to improve respiratory indices and prevent pulmonary complications. Why Have the Studies Been Negative? Poor Methodology is important to point out that poor study methodology complicates the ability to interpret studies of IS efficacy[9]

This study was conducted retrospectively to compare effectiveness of incentive spirometry and diaphragmatic breathing exercise on pulmonary function and diaphragmatic excursion in patients undergoing abdominal surgery. There were 25 patients included in each group were homogenous in terms of all demographic parameters. In our study we found that incentive spirometry along with diaphragmatic breathing improve lung function in patient s who has undergone abdominal surgery

Based on our study results, the pulmonary function { PEFR} after 6 hrs postoperatively although decreased but the difference in both the group is statistically insignificant.On 1st postoperative day had a significant decrease in both control and incentive spirometry groups. This is possibly owing to the fact that in the postoperative period there is shallow, monotonous breathing without periodic sighs and prolonged restraint in bed due to postoperative pain, incision site,

analgesics, duration of anaesthesia and surgery, all of which decrease the ventilation to dependent lung regions [10].From second day onwards there was significant difference in PEFR values of D and SDgroup.SD group showed improvement in respiratory functions .

In the immediate postoperative, the patient may present hypoventilation owing to the administration of anaesthesia which leads to ventilation-perfusion mismatch, hypoxaemia and shunt. Anaesthetic agents and narcotic analgesics depress the hypoxic ventilatory drive and suppress the normal periodic "sighing" respiration which is necessary for maintenance of normal lung inflation [11]. A reduction of the effectiveness of the cough reflex and increased risks associated with the retention of sputum are caused by impaired mucociliary clearance. Direct trauma to the abdominal wall and the incision affect diaphragmatic function [12]. This is due to reflex inhibition of the phrenic nerve after the manipulation of abdominal viscera [13]. All these factors impair the function of respiratory muscles which lead to decrease in functional residual and vital capacity [14]. In a study it has been suggested that chest physiotherapy helps in improving the distribution of ventilation and increasing clearance of secretions in surgical patients [15].

The possible reason for the improvement in pulmonary function in abdominal surgeries could be the use of incentive spirometry, which is a mechanical device used to encourage patients to take long, slow, sustained deep inspirations which leads to achieving maximal inflating pressure in the alveoli and maximal inhaled volume, and also helps to maintain the patency of the smaller airways. Postoperative hypoxaemia is reduced by using incentive spirometry which provides low-level resistance training to the diaphragm and minimizes fatigue thereby improving inspiratory muscle strength and enhancing lung inflation [16]

Our results are relevant with with Davis et al., who found that incentive spirometry is more effective than deep breathing exercise in restoring vital capacity to preoperative levels .If we promote diaphragmatic breathing,it improved final outcome of the patient.[17]Westwood et al., concluded that incentive spirometry plays a significant role in preventing atelectasis and its complications in major abdominal surgeries [18]It was found that abdominal surgery patients with surgical incisions close to the diaphragm were placed at a high risk of pulmonary complications. The researchers also stressed that incentive spirometry was effective as a pulmonary risk-reduction method [18]. Hall et al., showed that incentive spirometry was the most efficient prophylaxis against pulmonary complications in high risk patients after abdominal surgery [19]. Celli et al., compared intermittent positive-pressure breathing, incentive spirometry and deep

positive-pressure breathing, incentive spirometry and deep breathing exercises in patients who had undergone abdominal surgery and concluded that incentive spirometry showed significantly lower incidence of postoperative pulmonary complications.Mackey et al., suggests that early mobilization may reduce the incidence of postoperative pulmonary complications hence early mobilization was promoted in patients of both the groups. [20]

Our results are in accordance with Ford et al., who showed that reduction in inspiratory muscle activity, mainly the diaphragm, was the main determinant of impaired pulmonary function. Diaphragm dysfunction may be due to reflex inhibition of efferent phrenic activity [21].

In the present study, reduced pulmonary function (PEFR) and diaphragm excursion in postoperative abdominal surgery subjects might be due to postoperative pain, along with anaesthetic, analgesic usage .The effects of general anaesthesia on distribution of ventilation and chest wall and lung mechanics lead to ventilation-perfusion mismatch, increased dead space, shunt, and hypoxemia [22,23]. Narcotic/opioid analgesics and other drugs affect the central regulation of breathing, changing the neural drive of the upper airway and chest wall muscles, which lead to hypoventilation, a diminished sensitivity of the respiratory center to carbon dioxide stimulation, an increase of obstructive breathlessness, the suppression of the cough reflex, and irregular mucus production [24].

Vertical incision involves trauma near the diaphragm and chest wall/ribs, leading to postoperative incisional pain and reflex inhibition of the phrenic nerve and diaphragmatic reflex paresis resulting in functional disruption of respiratory muscle movement. In addition, when patients remain lying down for long periods during the postoperative period their abdominal content limits diaphragmatic movement All these factors lead to a change in postoperative lung function usually resulting in development of a restrictive pattern and decreased diaphragm excursion in abdominal surgery.

Erice et al. explained reduced pulmonary ventilation mainly due to decreased inspiratory muscle activity [26]

Possible reasons for improved pulmonary function and diaphragm excursion in the incentive spirometry group are as follows. The present study showed this group was able to improve pulmonary mechanics thus leading to a beneficial effect on pulmonary function and diaphragm excursion. Diaphragmatic breathing exercise improves diaphragmatic descent and diaphragmatic ascent during inspiration and expiration, respectively. Slower deep inspiration ensures more even distribution of air throughout the lung, particularly to the dependent lung . The physiological effects of diaphragmatic breathing exercise are that breathing through full vital capacity and holding for 3–5 seconds ensure full inflation of the lungs thus opening up alveoli which have low volume and stimulating the production of surfactant. Diaphragmatic breathing exercise will also decrease activity of accessory muscles, ensure that breathing patterns are as close to normal as possible, and also reduce the work of breathing Our results are in accordance with the findings of Tahir et al. who showed that diaphragmatic breathing exercise will improve basal ventilation [27]. Weber and Prayar and Menkes and Britt found that diaphragmatic breathing exercise will improve tidal volume and also facilitate secretion removal [28,29]. Blaney and Sawyer observed that tactile stimulation over the subject's lower costal margin as well as verbal instruction served to significantly increase diaphragmatic movement during diaphragmatic breathing exercises [30]. Manzano et al. found that diaphragmatic breathing exercise was able to improve pulmonary mechanics and lead to beneficial effect on Forced Vital Capacity (FVC) [31]The volume incentive spirometer will be more "physiological" because the training volume is constant until it reaches the maximum inspiratory capacity (level preset by physiotherapist). It provides a low level of resistance training while minimizing the potential fatigue to the diaphragm [32]]. Our study results are in accordance with Paisani et al. who showed that when volume incentive spirometry was performed with low inspiratory flow it promoted diaphragmatic excursion and improved the expansion of the basal area of chest wall. Minschaert et al. observed that patients treated with incentive spirometry would have early recovery of the pulmonary volume [33] These Results Comes In Agreement With (Kumar, 2016) Who Concluded That, Flow Incentive Spirometry Can Be Securely Prescribed To Patients With Open Abdominal Surgery as there Have Been No Unfavorable Outcomes Recorded. Additionally, These Showed Improvement In Pulmonary Function And Exercise Tolerance[34]

In Addition; The Results Of The Present Study Were In The Same Line With (Restrepo, 2011) Who Stated That, The Most Recent Recommendation On The Utilization Of Incentive Spirometry in Synergistic Effect Of Flow Incentive Spirometer And Diaphragmatic Breathing Exercise For Patients . [35]

Similarly (Carvalho, Et Al., 2011) Reported That, The Methods Including Diaphragmatic Breathing Exercise & Incentive Spirometry Enhance The Buildup Of A Large And Sustained Increase In The Transpulmonary Pressure, Which Ensure Expansion Of The Collapsed Alveolar Units.[36]

Our findings are similar to demonstration of shazley et al who proved that incentive spirometry in addition to diaphragmatic breathing is more beneficial in terms of respiratory outcome in patients who undergone open abdominal surgeries [37]

CONCLUSION & RECOMMENDATIONS

On the basis of the results Of the Study ,We Strongly Recommend The Following:Both Diaphragmatic Breathing Exercise And Incentive Spirometry Together Can Be Recommended Over Diaphragmatic Breathing Exercise Alone As An Intervention For The Improvement Of Pulmonary Function And Prevention Of Complications In The Patients With Abdominal Surgery.

Incentive spirometry is an inhalation-based prophylactic technique that encourages patients to mimic a natural deep sigh to periodically increase lung volume. As this technique is the prophylactic method of choice for many hospitals, several studies have tested its efficacy. Incentive spirometry is only as effective as cough/deep-breathing regimens and other means of postoperative pulmonary prophylaxis. No single prophylactic technique clearly outperforms all others in preventing pulmonary complications

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[37] IOSR Journal of Nursing and Health Science (IOSR-JNHS) e- ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 7, Issue 2 Ver. X (Mar-Apr .2018), PP 01-11 www.iosrjournals.org DOI: 10.9790/1959-0702100111 www.iosrjournals.org 1 | Page Synergistic Effect of Flow Incentive Spirometer and Diaphragmatic Breathing Exercise for Patients with Upper Abdominal Surgery Shazly B. Ali1 , Entisar Gaad-Elmoula Shabaan2 , Thanaa Mohammed Diab3 , Amal Fehro4 , Rania M. Eid5