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EFFECT OF ACTIVE CYCLE OF BREATHING TECHNIQUE AND INCENTIVE SPIROMETRY ON SPO2, CHEST EXPANSION AND DYSPNOEA IN A PATIENT WITH PLEURAL EFFUSION CAUSED BY MALIGNANT LUNG CARCINOMA: A CASE STUDY

Physiotherapy

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ABSTRACT

Background: Lung carcinoma, is a cancer that starts in the tissues of the lungs. It is typified by the lung's aberrant cells growing out of control, which can lead to tumors and impair regular breathing. Pleural effusion is a common occurrence in lung carcinoma. Cancer cells cause secretion of excess pleural fluid and prevent it from draining properly, causing pleural inflammation and accumulation of fluid in pleural cavity. This can lead to inflammation of the pleura and a buildup of fluid in the pleural space. ACBT can significantly improve secretion removal, SPO2, chest expansion and dyspnoea in patients with lung carcinoma. The forced expiratory technique (FET), thoracic expansion exercises, and breathing regulation comprise the cycle of ACBT. **Case Description:** A 53-year-old female agricultural worker with lung carcinoma was admitted in the oncology ward of a tertiary care hospital. The auscultatory findings of the patient are reduced air entry and presence of crackles in all lobes. Investigations of the lung and brain reveal right lung carcinoma with brain metastasis. **Intervention:** The patient was in long sitting position. Pre -measurements was done on the patient. After that 3cycles of ACBT with 3 sets of incentive spirometry was done. The vital signs were constantly monitored during the intervention. The intervention was performed for 14 days and after 14 days post-measurements was done. **Result:** Patient who received active cycle of breathing technique with incentive spirometry showed more improvement in all the three parameters. **Conclusion:** This clinical study concludes that ACBT, Incentive spirometry helps to improve chest expansion, dyspnoea and SPO2 in lung carcinoma patients.

KEYWORDS

lung carcinoma , pleural effusion, ACBT, incentive spirometry, SPO2, chest expansion , dyspnoea.

INTRODUCTION

Lung carcinoma is a disease with great morbidity and mortality. It affects the oxygenation of arterial blood, chest expansion and may cause dyspnoea. Pleural efusion is a common occurance in lung carcinoma.[10] Cancer cells cause secretion of excess pleural fluid and prevent it from draining properly, causing pleural inflammation and accumulation of fluid in pleural cavity. This can lead to inflammation of the pleura and a buildup of fluid in the pleural space. Due to an excessive accumulation of fluid in the pleural space[1], the patient most commonly complains of breathlessness, coughs and reduced chest expansion. Physiotherapy plays a crucial role in managing the respiratory complications associated with malignant pleural effusion that can cause significant symptoms such as dyspnoea, chest pain, and reduced chest expansion and reduced oxygenation.[9] Self administered techniques like Active Cycle of Breathing Technique (ACBT) and incentive spirometry may help to improve these outcomes[2].

Many studies have recommended the use of self efficacy based techniques to relieve the symptoms.[4] ACBT is an active breathing technique that helps to remove excess secretions and improve lung function. The forced expiratory technique (FET), thoracic expansion exercises, and breathing regulation comprise the cycle of ACBT.[6] The FET is a crucial component of the ACBT for the efficient elimination of respiratory tract secretions. It consists of one or two forced expirations or huffs followed by breathing regulation[3].

The purpose of incentive spirometry is to facilitate a sustained slow deep breath. Incentive spirometry is designed to mimic natural sighing by encouraging patients to take slow, deep breaths, using devices that provide visual cues to the patients that the desired flow or volume has been achieved.[5] The basis of incentive spirometry involves having the patient take a sustained, maximal inspiration that improves chest expansion and oxygenation.

Despite various therapeutic options, there is a need to evaluate the effectiveness of physiotherapy interventions for pleural effusion caused by lung carcinoma. The current literature predominantly focuses on medical and surgical treatments. This case study aims to show the effectiveness of certain physiotherapy techniques like ACBT and incentive spirometry on pleural effusion management, with a focus on symptom relief and improvement in quality of life.[7] The objective is to determine the role of physiotherapy in reducing hospital stay and enhancing patient outcomes.[8]

Case Description

A 53-year-old female agricultural worker presented with shortness of breath and bilateral chest pain which was more on the right side for the past one month. She had a history of right lung carcinoma and brain metastasis and was admitted to the oncology ward of a tertiary care hospital. The patient was conscious, oriented and afebrile at the time of admission. On auscultation, the findings indicate reduced air entry in all lung lobes, with crackles present in both lungs. She was a non smoker and did not have any family history of lung carcinoma. Previous medical history and investigations reveal malignant right lung adenocarcinoma with brain metastasis, for which the patient had earlier undergone chemotherapy. After several cycles of treatment, a slight reduction in the size of the tumor was observed. Subsequently, the patient developed pleural effusion, which was diagnosed as malignant fluid due to tumor involvement. During` pleural tapping for further diagnostic evaluation, air entered the pleural space, leading to a collapsed lung. As a result, an intercostal drain (ICD) was placed to manage the pleural effusion and prevent further respiratory compromise. This clinical scenario highlights the progression of the patient's disease, including the complications related to malignant pleural effusion and lung collapse, as well as the ongoing management with chemotherapy and drainage procedures. Patient did not have any other co morbidity. She was referred to physiotherapy for secretion removal and improvement of lung function.

During the initial physiotherapy assessment, the patient complained of dyspnea that interfered with her day to day activities, chest pain that was sharp, pleuritic in nature and worsened with deep breaths and right side lying. Chest assessment was done in long sitting position. Chest shape was bilaterally symmetrical with no tracheal shift. The patient had decreased breath sounds, productive cough and dullness to percussion bilaterally, indicating fluid buildup in the pleural space. Chest expansion was reduced at axilla, nipple and xiphisternal levels. SPO2 was reduced. Patient was tachypnoeic, tachycardia and had grade 1 clubbing. Exercise capacity was assessed by 6 minute walk test which showed significant reduction in the distance walked. Patient was prescribed paracetamol, zinc, antibiotics and anti-tussives.

Interventions

Materials And Equipments

Measuring Tape: Used to assess chest expansion by measuring the circumference of the chest at the level of axilla, nipple and xiphisternum. This helps monitor changes in lung volume and chest mobility over time.

Pulse Oximeter: A non-invasive device to measure SpO2 (oxygen saturation). It is used to monitor the patient's blood oxygen levels at baseline and during follow-up visits. This will help track the effectiveness of interventions on oxygenation.

Incentive Spirometer: A device that encourages the patient to take deep breaths to expand the lungs. It is used to monitor lung volume and promote lung expansion, aiming to prevent atelectasis, improve ventilation, and enhance oxygenation.

Outcome Measures

- **SpO2 (Oxygen Saturation):** Monitored throughout the study to assess the effectiveness of interventions in improving oxygenation levels. A higher SpO2 indicates better oxygen supply to tissues, which is crucial for patients with lung carcinoma.
- **Chest Expansion:** Measured using a measuring tape to monitor improvements in lung volume and thoracic mobility. Increased chest expansion may indicate better lung function and reduced restrictions caused by the carcinoma or pleural effusion.
- **Dyspnoea (Breathlessness):** Assessed using a modified Borg Dyspnoea Scale or similar tools to rate the patient's perceived level of breathlessness. The goal is to reduce the patient's subjective feeling of breathlessness through targeted respiratory interventions.

Table 1: Week Wise Exercise Protocol:

Week	Intervention	Technique	Exercise Prescription
01(0-7 days)	Active Cycle Of Breathing Technique (ACBT)	• Comprises of breathing control, deep breathing, huffing and coughing. • Patient instructed to sit upright in a chair or lean slightly forward. • Relax her neck, shoulders, upper chest, and arms. • Breathe in and out gently through nose. If not, breathe through mouth instead (patient breathe according to his own rate). • Try to let go of any tension in body with each breath out and keep shoulders relaxed. • Gradually try to make the breaths slower. • Take a long, slow and deep breath in, through nose and hold the air in lungs for 2-3 seconds before breathing out. • Breathe out gently and relaxed, like a sigh. Don't force the air out. • Perform 1-2 medium to high volume huffs. • Repeat the technique.	4 sets, given 4 times a day,
	Incentive Spirometry	• Patient instructed to sit up and hold the device and place the mouthpiece of the spirometer in mouth. Breathe out (exhale) normally. • Breathe in (inhale) slowly. A piece in the incentive spirometer will rise as patient breathes in. • Patient instructed to try to get this piece to rise as high as she can.	• 4 sets, given 4 times a day
	Deep breathing exercises	• Patient instructed to breathe in through nose for a count of 4. • Hold breath for a count of 4. • Breathe out for a count of 4. • Hold breath for a count of 4. • Repeat.	4 sets, given 4 times a day
02 (8-14 days)	Active Cycle Of Breathing Technique (ACBT)	• Technique as described above.	3 sets, given 3 times a day
	Incentive Spirometry	• Technique as described above.	• 3 sets, given 3 times a day
	Deep breathing exercises	• Technique as described above.	• 3 sets, given 3 times a day

Fig1: performing ACBT

Fig2: Performing Incentive Spirometry

Table 2: Outcome Measures

Outcome measures	Week 1(measured on Day 0)	Week 2 (measured on Day 7)	Week 2 (measured on Day 14)
SPO2	94%	95%	97%
Chest Expansion	At Axilla: 1.5 inches At Nipple: 1.0inch At Xiphisternum: 1.5 inches	At Axilla: 1.5inches At Nipple: 1.5 inches At Xiphisternum:1.5 inches	At Axilla: 2.0 inches At Nipple: 1.5 inches At Xiphisternum: 2.0 inches
Dys-pnoea	MRC Dyspnoea Scale: Grade 4	MRC Dyspnoea Scale: Grade 3	MRC Dyspnoea Scale: Grade 3

RESULTS

Post intervention analysis of active cycle of breathing technique along with incentive spirometry showed improvement in SPO2, chest expansion and dysponea. An increase in oxygen saturation, indicated a better pulmonary function and oxygen delivery to tissues. Increased chest expansion showed an improvement in lung volume, suggesting better ventilation and lung capacity. A decrease in breathlessness shows improved respiratory efficiency and better management of symptoms.

DISCUSSION

This case study focuses on improving peripheral oxygenation, chest expansion and dyspnoea in a patient with pleural effusion caused by lung carcinoma by means of ACBT and incentive spirometry. The strength of this study is that it focuses on self administered techniques that are easy to use for managing pleural effusion caused by lung carcinoma. This study however has its limitations. As this treatment approach is found to be beneficial only for one subject, it is difficult to generalize this mode of treatment for all the subjects presenting with the same condition.

CONCLUSION

We conclude that Active Cycle of Breathing Technique (ACBT) along with incentive spirometry has beneficial effect on SPO2, chest expansion and dyspnoea in a patient with pleural effusion caused by malignant lung carcinoma.

Clinical Implication

Active cycle of breathing technique and incentive spirometry can be implemented effectively to improve SPO2, Chest expansion and Dyspnea in patients with pleural effusion caused by lung carcinoma.

Abbreviations

ACBT: Active Cycle Of Breathing Technique
SPO2: Saturation of Oxygen in Peripheral Blood
FET: Forced Expiratory Technique
MRC: Medical Record Council

Acknowledgement:

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