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Research Article

Effectiveness of Thoracic Mobility Exercises and Chest Proprioceptive Neuromuscular Facilitation Technique on Pulmonary Function in Postoperative Breast Cancer Patients: A Randomised Controlled Trial

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A B S T R A C T

Background: The most prevalent form of cancer is breast cancer. Its treatment options have some early and late consequences which include respiratory disorders, reduced chest mobility, and decreased muscle strength. Exercises for thoracic mobility include deep breathing and active movements of the trunk and extremities. This article's objective was to ascertain the effectiveness of thoracic mobility exercise and chest Proprioceptive Neuromuscular Facilitation (PNF) technique on respiratory function in postoperative breast cancer patients.

Method: This was a randomised controlled trial. The participants (n = 34) were divided into two groups, Group A was the Conventional group and Group B was the Control group. Subjects in Group A performed thoracic mobility exercises along with breathing exercises and subjects in Group B performed chest PNF technique along with breathing exercises for four weeks. All patients were assessed with thoracic expansion measurements and pulmonary function tests before and after the treatment.

Results: After a 4-week rehabilitation programme, statistically significant variations were seen in spirometry parameters such as forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1). Evaluation of the patient's thoracic expansion revealed significant differences between the groups, according to statistics.

Conclusion: A regular rehabilitation programme for postoperative breast cancer patients along with additional therapeutic techniques such as chest PNF had a positive impact on pulmonary function.

Keywords: Thoracic Mobility, Chest PNF, Breast Cancer, Pulmonary Function

Introduction

The most frequent type of cancer among women is breast cancer, which is also a leading cause of death. According to WHO, more than one million instances are detected each year, accounting for about a quarter of all malignant tumours in women and one in every 100 men.[1] The frequency of its occurrence is increasing with time. Women with breast cancer account for 25% of all female patients undergoing oncological treatment. Surgery, systemic therapy which includes chemotherapy and hormonal therapy, and radiotherapy are treatment options for this condition.[2]

Surgical treatment is the most fundamental and necessary option. Immobilisation and a large postoperative wound are early effects of surgical treatment. Other consequences include respiratory disorders, decreased chest mobility and reduced muscle strength.[3] Exposing the lung tissue of females to ionising radiation during radiotherapy causes a decrease in pulmonary efficiency later on. Furthermore, radical mastectomy can cause decreased thoracic mobility, disruption of ventilatory mechanics, and impaired respiratory system function. In pulmonary function, postoperative complications have a detrimental influence on forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FVC/FEV1 ratio. According to research conducted by Krengli et al., a significant drop is seen in FVC and FEV1 after mastectomy and radiotherapy.[4] On day 90 after completing locoregional postmastectomy radiation, a significant decrease in PFT values was observed in another study.[5] In such conditions, a decrease is seen not only in pulmonary function but also in thoracic mobility.

The flexibility of the soft tissues and the strength of the breathing muscles control the thorax's capacity, all thereby influencing lung expansion and contraction.[6] The maximum effort exerted by the muscles employed in chest expansion while breathing determines the strength of respiratory muscles. Many studies have found that a decrease in chest circumference in postoperative breast cancer patients affects breathing and hence pulmonary function.

There are many studies on Physiotherapy interventions after oncological breast cancer treatment, but none of the articles has suggested an intervention strategy to increase chest mobility and improve pulmonary function. Thoracic mobility exercises and chest proprioceptive neuromuscular facilitation (PNF) technique can be useful in this field. Thoracic mobility exercises are exercises which combine various motions of the trunk and upper limbs with deep breathing exercises and are beneficial for thoracic cage movement. When it comes to ventilation and body alignment, they are meant to maintain or promote mobility of the chest wall, trunk and shoulder girdle. Using external proprioceptive stimulation, the chest PNF approach induces reflex respiratory movement. Therapeutic methods are required to increase breathing and exercise capacity by improving the function of respiratory muscles. The purpose of breathing exercise intervention is to increase respiratory muscle strength, endurance and coordination.[7] By slowing down the respiratory rate and relaxing the accessory muscles, deep breathing exercises can minimise the work of breathing. Diaphragmatic and pursed-lip breathing methods are additionally helpful in enhancing pulmonary function.[8]

The objective of this study was to determine the effect of thoracic mobility exercise and chest PNF technique on pulmonary function in postoperative breast cancer patients.

Materials and Methodology

Thirty-four breast cancer patients were initially enrolled in the study and were randomly assigned to the Conventional group (n = 17) and the Control group (n = 17) after obtaining informed consent. The study was carried out in Krishna Vishwa Vidyapeeth, deemed to be University, Karad. Approval for the study was received from the protocol committee and the ethics committee of Krishna Vishwa Vidyapeeth, deemed to be University. This randomised controlled trial was conducted from January 2023 to March 2023.

Inclusion and Exclusion Criteria

The participants selected as per the inclusion criteria were female postoperative breast cancer (stage 1–3) patients (according to the TNM, i.e. tumour, nodes and metastasis staging system) belonging to the age group of 30–50 years who were undergoing radiation therapy, had restricted chest mobility and were willing to participate in the study. Exclusion criteria included patients with stage 4 breast cancer (according to the TNM staging system), patients previously diagnosed with any respiratory condition, patients having diseases which affected the outcome - osteoporosis/ stroke, and patients who had taken physiotherapy treatment in the last one month.

Assessment Parameters

Every subject underwent testing for pulmonary function (spirometry in accordance with the American Thoracic Society guidelines) and chest expansion measurements at the axillary level, nipple level, and xiphisternal level. All measurements were obtained at the beginning of the rehabilitation programme and at the end of the 4th week.

Method

Prior to the study, an explanation of the entire procedure was given to all subjects and written consent was taken. The 17 subjects of Group A performed thoracic mobility exercises along with breathing exercises and those of Group B performed chest PNF technique along with breathing exercises. In both groups, exercises were carried out three

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times per week for 4 weeks. Each session lasted for 40–45 minutes. The outcome measures were evaluated before and after the intervention. Statistical analysis and interpretation were done for each individual to examine the effectiveness of the treatment for each subject.

- **Group A (Conventional group):** Subjects performed thoracic mobility exercises along with breathing exercises which included diaphragmatic breathing and pursed lip breathing techniques.
- **Group B (Control group):** Subjects performed the following chest PNF techniques:

1. Intercostal stretch
2. Co-contraction of abdomen

Both techniques were performed along with breathing exercises that comprised diaphragmatic breathing and pursed lip breathing techniques.

Statistical Analysis

The Instat software was used to analyse the data. The differences between groups and within groups for variables related to pulmonary function and chest expansion were examined using independent t test and paired t test, respectively.

Results

The differences regarding pulmonary function and chest expansion observed on the last day of the fourth week between Groups A and B, and within Groups A and B are shown in Tables 1–3 respectively.

Table 1.Comparison of Variables between Conventional Group and Control Group

Pre-intervention Comparison				
Variables	**Conventional Group (Mean ± SD)**	**Control Group (Mean ± SD)**	**t Value**	**p Value**
FVC	3.50 ± 0.27	3.37 ± 0.22	1.4320	0.1714^{NS}
FEV1	2.41 ± 0.22	1.59 ± 0.23	2.4380	0.1873^{NS}
FVC/FEV1	62.85 ± 1.52	55.93 ± 2.55	9.8340	0.1382^{NS}
Axillary level	45.94 ± 6.60	47.17 ± 6.30	0.5530	0.5841^{NS}
Nipple level	38.70 ± 4.70	39.41 ± 4.70	0.4316	0.6689^{NS}
Xiphisternal level	35.94 ± 4.30	36.23 ± 4.45	0.1951	0.8465^{NS}
Post-intervention Comparison				
FVC	3.60 ± 0.29	3.48 ± 0.29	49.5890	< 0.0001**
FEV1	2.63 ± 0.48	1.83 ± 0.35	22.4240	< 0.0001**
FVC/FEV1	63.88 ± 1.50	60.64 ± 2.02	167.0800	< 0.0001**
Axillary level	51.47 ± 4.70	52.05 ± 4.50	3.9220	0.0012*
Nipple level	35.29 ± 3.30	36.11 ± 3.40	6.4240	< 0.0001**
Xiphisternal level	44.58 ± 4.60	45.05 ± 4.50	3.7710	0.0017*

FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in One second, NS: Not significant, *: Significant, **: Extremely significant

Table 2.Comparison of Variables within Conventional Group

Variables	**Pre-intervention (Mean ± SD)**	**Post-intervention (Mean ± SD)**	**t Value**	**p Value**
FVC	3.50 ± 0.27	3.60 ± 0.29	4.432	0.0004*
FEV1	2.41 ± 0.22	2.63 ± 0.48	1.875	0.0291*
FVC/FEV1	62.85 ± 1.52	63.88 ± 1.5	3.851	0.0014*
Axillary level	45.94 ± 6.6	51.47 ± 4.7	2.523	0.0226*
Nipple level	38.70 ± 4.7	35.29 ± 3.3	2.799	0.0129*
Xiphisternal level	35.94 ± 4.3	44.58 ± 4.6	5.737	< 0.0001**

FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in One second, *: Significant, **: Extremely significant

Table 3.Comparison of Variables within the Control Group

Variables	**Pre-intervention (Mean ± SD)**	**Post-intervention (Mean ± SD)**	**t Value**	**p Value**
FVC	3.37 ± 0.22	3.48 ± 0.29	61.102	< 0.0001**

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FEV1	1.59 ± 0.23	1.83 ± 0.35	27.820	< 0.0001**
FVC/FEV1	55.93 ± 2.55	60.64 ± 2.02	90.332	< 0.0001**
Axillary level	47.41 ± 6.30	52.05 ± 4.50	2.278	0.0368*
Nipple level	39.41 ± 4.70	36.11 ± 3.40	2.659	0.0172*
Xiphisternal level	36.23 ± 4.45	45.05 ± 4.50	5.688	< 0.0001**

FVC: Forced Vital Capacity, FEV1: Forced Expiratory Volume in One second, *: Significant, **: Extremely significant

After analysing the data in this study, we found that there was a substantial difference Conventional group and the Control group after treatment. Chest PNF techniques had improved pulmonary function in postoperative breast cancer patients as p values were extremely significant in the case of the Control group.

Discussion

The goal of the study was to determine the effectiveness of thoracic mobility exercises and chest PNF technique on pulmonary function in postoperative breast cancer patients. A randomised control trial was conducted in this study. The findings of this study revealed that Conventional and Control groups showed an improvement in pulmonary function and chest expansion.

The participants in this study who underwent chest PNF techniques along with breathing exercises for four weeks (Control group) had a clinically significant rise in FVC (12.00%), FEV1 (20.00%) and FVC/FEV1 ratio (8.00%). The participants who underwent thoracic mobility exercises along with breathing exercises for four weeks in a Conventional group) showed a significant rise in FVC (10.84%), FEV1 (16.00%) and FVC/FEV1 ratio (6.00%).

Chest PNF techniques along with breathing exercises have been shown to be effective in enhanced pulmonary function. One major outcome of this study is that both groups improved significantly in chest expansion after a 4-week intervention programme. The most likely explanation would be that the primary respiratory muscles receive proprioceptive stimulation from chest PNF, which may account for this by boosting functionality and enhancing chest wall motion. Additionally, it makes the diaphragm and abdominal muscles more active. The inflexible chest wall muscles may experience autogenic inhibition, which encourages chest wall movement. PNF also boosts chest wall mobility by increasing stress relaxation in the muscles that line the wall.[9]

The traditional treatment of breathing exercises in this trial had a positive impact on chest wall enlargement and FVC. The physiology that might be responsible for this improvement is the patient's capacity to control their breathing through these types of workouts and a consequent decrease in the tension in their respiratory muscles, which can be better employed during respiration. Additionally, it has a soothing effect which makes breathing easier in painful conditions too.

This will help to design the rehabilitation programme for postoperative breast cancer patients for the improvement in their pulmonary function, which will help to improve exercise efficiency and hence the quality of life. The study's limitations include a limited sample size and a shorter duration of the intervention programme. Future studies can be done on large sample sizes with a larger duration of intervention.

Conclusion

The addition of chest PNF techniques to the regular rehabilitation programme had a positive impact on the enhancement of pulmonary function in postoperative breast cancer patients.

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Conflict of Interest: None

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