

Comparative Study to Assess the Effectiveness of High Frequency Chest Wall Oscillation Versus Chest Physiotherapy on Lung Function Among COPD Patients in Narayana Medical College Hospital, Nellore

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Abstract

Introduction: Chronic Obstructive Pulmonary Disease is a progressive respiratory disorder characterized by persistent airflow limitation, chronic inflammation, cough, sputum production and breathlessness. COPD includes chronic bronchitis, emphysema and chronic obstructive airway disease. It is one of the major causes of morbidity and mortality worldwide and creates a significant burden on patients, families and the health-care system. Airway clearance is an important supportive measure in the management of COPD, especially among patients with excessive bronchial secretions. High Frequency Chest Wall Oscillation and conventional chest physiotherapy are two airway clearance techniques used to mobilize pulmonary secretions and improve ventilation. The present study aimed to compare the effectiveness of High Frequency Chest Wall Oscillation versus chest physiotherapy on lung function among COPD patients.

Materials and Methods: A comparative study with factorial research design was conducted among 60 COPD patients admitted in the Pulmonology wards of Narayana Medical College Hospital, Nellore. Among them, 30 patients were assigned to the High Frequency Chest Wall Oscillation group and 30 patients were assigned to the chest physiotherapy group. Data were collected using pulmonary function parameters such as Forced Vital Capacity and Forced Expiratory Volume in one second, along with COPD assessment measures. The intervention was carried out for a period of one month. Data were analyzed using descriptive and inferential statistics.

Results: The study findings revealed a significant improvement in lung function after both interventions. A significant mean difference was observed in the High Frequency Chest Wall

Oscillation group from 19.86 ± 1.12 to 21.93 ± 1.06 , with $p < 0.001$. In the chest physiotherapy group, the mean score improved from 8.53 ± 0.75 to 19.13 ± 1.26 , with $p < 0.001$. The independent 't' test value was 4.102, which was statistically significant at $p < 0.001$, indicating a significant difference between the two interventions. Based on the comparative findings, chest physiotherapy was found to be more effective than High Frequency Chest Wall Oscillation in improving lung function among COPD patients.

Discussion: The study concluded that both High Frequency Chest Wall Oscillation and chest physiotherapy were effective in improving lung function among COPD patients. However, chest physiotherapy showed comparatively greater effectiveness. Regular use of chest physiotherapy under nursing supervision can improve airway clearance, promote lung expansion and reduce respiratory discomfort among COPD patients.

Key Words: Chest physiotherapy, High Frequency Chest Wall Oscillation, lung function, COPD, effectiveness.

Introduction

Chronic Obstructive Pulmonary Disease is a chronic, progressive and preventable respiratory disorder that affects millions of people worldwide. It is characterized by persistent respiratory symptoms and airflow limitation due to airway and alveolar abnormalities. The major clinical features of COPD include chronic cough, increased sputum production, wheezing, chest tightness, fatigue and progressive dyspnoea. COPD commonly includes chronic bronchitis, emphysema and chronic obstructive airway disease.

COPD is a major public health problem because it affects the physical, psychological, social and economic well-being of patients. The disease usually develops slowly and worsens over time. In the early stages, patients may experience mild breathlessness during exertion. As the disease progresses, breathlessness may occur even during routine daily activities such as walking, bathing, dressing or climbing stairs. In severe cases, patients may require repeated hospitalization, oxygen therapy and long-term respiratory support.

The major risk factor for COPD is tobacco smoking. Other contributing factors include exposure to biomass fuel smoke, occupational dust, air pollution, recurrent respiratory infections, poor

housing conditions and genetic susceptibility. In India, COPD is common not only among smokers but also among people exposed to indoor air pollution from cooking fuels. Many patients remain undiagnosed until the disease reaches a moderate or severe stage.

The pathophysiology of COPD involves chronic inflammation of the airways, destruction of alveolar walls, narrowing of bronchioles, excessive mucus production and loss of lung elasticity. These changes result in air trapping, reduced gas exchange and difficulty in expiration. Accumulation of secretions further worsens airway obstruction and increases the risk of infection. Therefore, airway clearance becomes an important component of COPD care.

Medical management of COPD includes bronchodilators, corticosteroids, antibiotics during infective exacerbations, mucolytics, oxygen therapy, pulmonary rehabilitation and lifestyle modification. Along with pharmacological management, non-pharmacological interventions play a significant role in improving respiratory function and quality of life. Chest physiotherapy and High Frequency Chest Wall Oscillation are two such interventions used to mobilize secretions and improve ventilation.

Chest physiotherapy is a traditional and widely used technique that includes postural drainage, percussion, vibration, deep breathing exercises, coughing techniques and breathing retraining. These methods help loosen bronchial secretions, promote expectoration, improve ventilation and prevent complications such as atelectasis and respiratory infections.

High Frequency Chest Wall Oscillation is a mechanical airway clearance technique in which an inflatable vest is connected to an air pulse generator. The vest produces rapid oscillations over the chest wall, which helps loosen mucus from the bronchial walls and moves secretions towards larger airways for expectoration. It is commonly used in conditions associated with mucus retention and may be beneficial for selected COPD patients.

Medical-surgical nurses play a vital role in the care of patients with COPD. They assess respiratory status, monitor oxygen saturation, observe breathing pattern, administer medications, provide chest physiotherapy, encourage breathing exercises, educate patients and support pulmonary rehabilitation. Nurses also help patients adopt lifestyle changes such as smoking cessation, infection prevention, medication adherence and energy conservation.

The present study was conducted to compare the effectiveness of High Frequency Chest Wall Oscillation versus chest physiotherapy on lung function among COPD patients admitted in the Pulmonology wards of Narayana Medical College Hospital, Nellore.

Need and Significance of the Study

COPD is one of the leading causes of chronic illness and death globally. It causes long-term disability and affects the patient's ability to perform activities of daily living. Many patients with COPD experience repeated exacerbations, frequent hospital admissions and reduced quality of life. Respiratory distress, fatigue, cough and excessive sputum production are common problems faced by these patients.

One of the major clinical concerns in COPD is ineffective airway clearance. Due to chronic inflammation and mucus hypersecretion, patients often find it difficult to clear secretions from the lungs. Retained secretions can obstruct airways, reduce oxygen exchange and increase the risk of respiratory infection. Therefore, interventions that help remove secretions and improve lung expansion are essential in COPD management.

Chest physiotherapy has been used for many years in the management of respiratory disorders. It is simple, cost-effective and can be performed by trained nurses or physiotherapists. Techniques such as percussion, vibration, postural drainage, deep breathing and coughing exercises help mobilize secretions and improve ventilation. Chest physiotherapy also encourages patient participation and can be continued as part of home care education.

High Frequency Chest Wall Oscillation is a newer and more technology-based method of airway clearance. It provides external chest wall vibrations through a mechanical vest. These oscillations help loosen mucus and promote its movement towards the central airways. It may be useful for patients who are weak, unable to perform active coughing or unable to tolerate manual chest physiotherapy. However, it requires equipment, cost and trained personnel for proper use.

Comparing these two methods is important because health-care professionals need evidence to select the most effective and feasible intervention for COPD patients. In a hospital setting, both manual and mechanical airway clearance techniques may be available. However, the choice of

intervention should depend on patient condition, availability of equipment, cost-effectiveness, clinical outcome and patient comfort.

The present study is significant because it evaluates two commonly used airway clearance interventions in COPD patients. The findings can help nurses, physiotherapists and physicians decide which intervention is more beneficial in improving lung function. The study also contributes to evidence-based medical-surgical nursing practice.

In nursing care, respiratory interventions should not be performed as routine procedures alone; they should be evaluated for measurable outcomes. Pulmonary function tests such as Forced Vital Capacity and Forced Expiratory Volume in one second provide objective information about lung function. The COPD assessment test also helps understand the patient's symptom burden and functional status.

The study conducted at Narayana Medical College Hospital, Nellore, provides useful clinical evidence for respiratory nursing practice. It emphasizes the need for systematic assessment, planned intervention and evaluation of outcomes among COPD patients. The findings also support the role of nurses in pulmonary rehabilitation and respiratory care.

Objectives, Hypothesis and Methodology

Statement of the Problem

A comparative study to assess the effectiveness of High Frequency Chest Wall Oscillation versus chest physiotherapy on lung function among COPD patients in Narayana Medical College Hospital, Nellore.

Objectives of the Study

1. To assess the pre-intervention lung function among COPD patients in the High Frequency Chest Wall Oscillation group.
2. To assess the pre-intervention lung function among COPD patients in the chest physiotherapy group.
3. To evaluate the effectiveness of High Frequency Chest Wall Oscillation on lung function among COPD patients.

4. To evaluate the effectiveness of chest physiotherapy on lung function among COPD patients.
5. To compare the effectiveness of High Frequency Chest Wall Oscillation and chest physiotherapy on lung function among COPD patients.

Research Hypothesis

H1: There will be a significant difference in lung function among COPD patients receiving High Frequency Chest Wall Oscillation and those receiving chest physiotherapy.

Operational Definitions

Effectiveness: In this study, effectiveness refers to improvement in lung function scores after the intervention.

High Frequency Chest Wall Oscillation: It refers to a mechanical airway clearance technique using an oscillatory vest that delivers rapid vibrations to the chest wall to mobilize bronchial secretions.

Chest Physiotherapy: It refers to manual airway clearance techniques including postural drainage, percussion, vibration, deep breathing and coughing exercises.

Lung Function: It refers to respiratory function assessed through pulmonary function test parameters such as Forced Vital Capacity and Forced Expiratory Volume in one second, along with COPD assessment measures.

COPD Patients: Patients diagnosed with Chronic Obstructive Pulmonary Disease and admitted in the Pulmonology wards of Narayana Medical College Hospital, Nellore.

Research Approach

A quantitative research approach was adopted for the study because the objective was to measure and compare the effectiveness of two interventions using numerical data.

Research Design

A comparative study with factorial research design was used. This design was appropriate because the study compared two intervention groups: High Frequency Chest Wall Oscillation group and chest physiotherapy group.

Setting of the Study

The study was conducted in the Pulmonology wards of Narayana Medical College Hospital, Nellore. This hospital was selected because it provides specialized care to patients with respiratory disorders, including COPD.

Population

The population of the study consisted of patients diagnosed with COPD and admitted in the Pulmonology wards.

Sample and Sample Size

The sample consisted of 60 COPD patients. Among them, 30 patients were assigned to the High Frequency Chest Wall Oscillation group and 30 patients were assigned to the chest physiotherapy group.

Sampling Technique

The study used a suitable sampling approach to select COPD patients who fulfilled the inclusion criteria. The selected patients were assigned to two groups for comparison.

Inclusion Criteria

Patients diagnosed with COPD, admitted in the Pulmonology wards, willing to participate in the study and available during the period of data collection were included.

Exclusion Criteria

Patients with severe respiratory distress requiring emergency ventilatory support, patients with unstable cardiac conditions, patients with chest wall injuries and patients who were not willing to participate were excluded.

Tools for Data Collection

Data were collected using pulmonary function test parameters such as Forced Vital Capacity and Forced Expiratory Volume in one second. COPD assessment measures were also used to evaluate symptom burden and respiratory status. Demographic and clinical variables were collected through a structured data sheet.

Intervention and Results

Description of High Frequency Chest Wall Oscillation

High Frequency Chest Wall Oscillation was administered using a mechanical oscillatory vest. The vest was placed around the patient's chest and connected to an air pulse generator. The device produced rapid compressions and relaxations of the chest wall. These oscillations helped loosen mucus from the airway walls and promoted movement of secretions towards larger airways. Patients were encouraged to cough and expectorate secretions after the session.

This intervention is useful because it provides uniform vibration to the chest wall and reduces the physical effort required from the caregiver. It may be especially helpful for patients who are unable to tolerate manual percussion or those who have difficulty performing active airway clearance techniques.

Description of Chest Physiotherapy

Chest physiotherapy was provided using conventional airway clearance techniques. It included postural drainage, percussion, vibration, deep breathing exercises and coughing techniques. Postural drainage helped drain secretions from specific lung segments using gravity. Percussion and vibration helped loosen secretions. Deep breathing exercises promoted lung expansion, and coughing techniques helped remove secretions from the airway.

Chest physiotherapy also involved patient participation. Patients were instructed to take deep breaths, perform effective coughing and cooperate during positioning. The intervention helped improve secretion clearance, reduce airway obstruction and promote better ventilation.

Data Collection Procedure

The study was conducted for a duration of one month. After obtaining permission from the hospital authority and consent from participants, baseline data were collected. Pulmonary function tests were performed before the intervention to assess pre-test lung function. COPD assessment measures were also recorded.

The High Frequency Chest Wall Oscillation group received the mechanical oscillation intervention as per the planned protocol. The chest physiotherapy group received conventional chest physiotherapy. After completion of the intervention period, post-test lung function was assessed using the same parameters. The collected data were organized and analyzed using descriptive and inferential statistics.

Results Related to High Frequency Chest Wall Oscillation

The findings showed that the mean lung function score in the High Frequency Chest Wall Oscillation group increased from 19.86 ± 1.12 to 21.93 ± 1.06 after intervention. The improvement was statistically significant at $p < 0.001$. This indicates that High Frequency Chest Wall Oscillation was effective in improving lung function among COPD patients.

The improvement may be due to mechanical loosening of bronchial secretions, better mucus mobilization and improved airway clearance. The oscillatory pressure delivered through the chest wall may have helped in reducing secretion retention and improving ventilation.

Results Related to Chest Physiotherapy

The findings showed that the mean score in the chest physiotherapy group improved from 8.53 ± 0.75 to 19.13 ± 1.26 after intervention. The improvement was statistically significant at $p < 0.001$. This indicates that chest physiotherapy was effective in improving lung function among COPD patients.

The improvement may be due to the combined effect of postural drainage, percussion, vibration, deep breathing and coughing exercises. These techniques help mobilize secretions, expand the lungs and improve respiratory efficiency.

Comparison Between the Two Groups

The independent 't' test value was 4.102, which was statistically significant at $p < 0.001$. This shows that there was a significant difference between the effectiveness of High Frequency Chest Wall Oscillation and chest physiotherapy on lung function among COPD patients.

Based on the comparative analysis and interpretation of the study findings, chest physiotherapy was found to be more effective than High Frequency Chest Wall Oscillation. Although both interventions were beneficial, chest physiotherapy showed greater clinical usefulness in improving lung function among COPD patients in this study.

Discussion and Nursing Implications

Discussion

The present study compared the effectiveness of High Frequency Chest Wall Oscillation and chest physiotherapy on lung function among COPD patients. The findings revealed that both interventions produced statistically significant improvement in lung function. However, chest physiotherapy was found to be more effective than High Frequency Chest Wall Oscillation.

COPD patients commonly experience airway obstruction due to mucus retention, bronchial inflammation and reduced expiratory airflow. Airway clearance techniques are important supportive measures because they help mobilize and remove secretions. When secretions are removed effectively, airway resistance decreases, ventilation improves and breathing becomes easier.

The improvement observed in the High Frequency Chest Wall Oscillation group may be attributed to the effect of mechanical oscillations on mucus mobilization. The oscillatory vest produces rapid chest wall vibrations that loosen secretions from the bronchial walls. This makes it easier for patients to cough out secretions. HFCWO may be useful for patients who cannot tolerate manual therapy or who require assisted airway clearance.

The improvement observed in the chest physiotherapy group may be due to the combined benefits of positioning, percussion, vibration, deep breathing and coughing. Chest physiotherapy not only helps in secretion clearance but also improves lung expansion. It encourages active

participation of the patient, which may improve respiratory muscle function and confidence in breathing control.

The finding that chest physiotherapy was more effective may be related to its comprehensive nature. Unlike HFCWO, which mainly provides mechanical oscillation, chest physiotherapy includes multiple techniques that address different aspects of respiratory care. It includes mobilization of secretions, promotion of lung expansion, breathing retraining and effective coughing. It can also be modified according to the patient's condition, tolerance and affected lung area.

From a clinical perspective, chest physiotherapy is also more accessible and cost-effective. It does not require expensive equipment and can be performed by trained nurses or physiotherapists. This is especially important in resource-limited settings where advanced devices may not be available for every patient.

The study findings emphasize that nurses should not depend only on mechanical devices for airway clearance. Conventional chest physiotherapy remains a valuable intervention in medical-surgical nursing practice. However, the choice of intervention should always be individualized according to patient condition, disease severity, tolerance, availability of equipment and clinical judgment.

Nursing Implications

Nursing Practice

Nurses working in pulmonology wards should regularly assess respiratory status among COPD patients. Assessment should include respiratory rate, oxygen saturation, cough, sputum quantity, sputum character, breath sounds, use of accessory muscles and patient comfort. Based on assessment findings, nurses can plan suitable airway clearance interventions.

Chest physiotherapy should be performed carefully and safely. Nurses should explain the procedure to the patient, provide privacy, position the patient correctly, monitor tolerance and encourage effective coughing after the procedure. Patients should be observed for fatigue, breathlessness, chest discomfort, cyanosis or oxygen desaturation.

Nursing Education

Nursing students should be trained in respiratory assessment and chest physiotherapy techniques. They should understand the principles of postural drainage, percussion, vibration, deep breathing and coughing exercises. Simulation and demonstration can help students develop skill and confidence.

Nursing Administration

Nursing administrators should ensure availability of trained personnel, standard protocols and necessary equipment for respiratory care. In-service education programmes can be organized for staff nurses regarding COPD management, oxygen therapy, airway clearance and pulmonary rehabilitation.

Nursing Research

Further studies can be conducted with larger sample size and randomized controlled design. Studies can also compare long-term outcomes such as frequency of exacerbations, duration of hospital stay, quality of life and patient satisfaction. Research may also explore combined use of HFCWO and chest physiotherapy.

Conclusion, Limitations, Recommendations and References

Conclusion

COPD is a chronic respiratory disorder that causes progressive airflow limitation, breathlessness, cough and sputum production. Ineffective airway clearance is a common problem among COPD patients and contributes to worsening respiratory symptoms. Therefore, airway clearance interventions are an important component of COPD management.

The present study compared the effectiveness of High Frequency Chest Wall Oscillation and chest physiotherapy on lung function among COPD patients admitted in Narayana Medical College Hospital, Nellore. The study included 60 COPD patients, with 30 patients in the High Frequency Chest Wall Oscillation group and 30 patients in the chest physiotherapy group.

The findings showed that both interventions were effective in improving lung function. The High Frequency Chest Wall Oscillation group showed significant improvement from 19.86 ± 1.12 to 21.93 ± 1.06 . The chest physiotherapy group also showed significant improvement from 8.53 ± 0.75 to 19.13 ± 1.26 . The independent 't' test value was 4.102, which was significant at $p < 0.001$. Based on the comparison, chest physiotherapy was found to be more effective than High Frequency Chest Wall Oscillation.

The study concluded that chest physiotherapy is a useful, cost-effective and clinically beneficial intervention for improving lung function among COPD patients. It should be included as an essential component of nursing care in pulmonology wards. Nurses should be trained to perform chest physiotherapy safely and effectively. Patient education regarding breathing exercises, coughing techniques, hydration, medication adherence and avoidance of respiratory irritants should also be emphasized.

Limitations of the Study

The study was limited to 60 COPD patients admitted in one hospital. The duration of intervention was one month. Long-term follow-up was not included. The study focused mainly on lung function parameters and COPD assessment measures. Other outcomes such as quality of life, hospitalization duration and exacerbation rate were not assessed.

Recommendations

A similar study can be conducted with a larger sample size. A randomized controlled trial can be conducted to strengthen the evidence. A study may be conducted to assess the combined effect of chest physiotherapy and High Frequency Chest Wall Oscillation. Long-term studies can be conducted to evaluate quality of life and reduction in hospital readmissions. Educational programmes can be developed for nurses and patients regarding airway clearance techniques in COPD.

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