EFFECTS OF DIFFERENT EXERCISE THERAPIES ON OBSTRUCTION, DYSPNEA, AND QUALITY OF LIFE IN COPD PATIENTS: A SYSTEMATIC REVIEW

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ABSTRACT
Objective: Chronic obstructive pulmonary disease (COPD) is the third leading cause of death, causes pulmonary and extra-pulmonary symptoms, and also impacts the quality of life. Rigorous evidence on manual and mechanical chest physiotherapy is still scarce. Therefore, this review aims to evaluate the effects of different exercise therapies on obstruction, dyspnea, and quality of life in COPD patients.

Materials and Methods: We performed a systematic review of randomized controlled trials published from 2011 to 2020 to evaluate the effects of exercise therapies on obstruction, dyspnea, and quality of life in obstructive patients. Databases such as Medline, BioMed Central, CINHAL, and Cochrane were reviewed. Methodological quality and risk of bias were assessed using the Cochrane tool.

Results: Most of the trials supported the effectiveness of mechanical chest physiotherapy in improving obstruction, dyspnea, and quality of life.

Conclusion: High-to-moderate evidence shows that mechanical chest physiotherapy is useful in the improvement of obstruction, dyspnea, and quality of life in COPD patients.

Keywords: Borg dyspnea scale, COPD, High-frequency chest wall oscillation, mMRC dyspnea scale, St. George Respiratory Questionnaire, Spirometry

INTRODUCTION

According to the WHO-Global initiative for Chronic Obstructive Pulmonary Disease (GCOPD), Chronic Obstructive Pulmonary Disease (COPD) has pulmonary and extra-pulmonary symptoms, which impact the quality of life¹. The prevalence of COPD as a health problem is increasing. There has been a need for advances in the rehabilitation field to control COPD symptoms². In 2010, it was ranked as the third worldwide cause of death; however, it will be the fourth-largest cause of death by 2030³. Due to the high prevalence of smoking in some high-income countries, the burden on COPD has been reported to be high in these settings¹. More than 10% of older individuals with COPD are greater than 40 years⁵. It is characterized by chronic airflow limitation, limb muscle dysfunction, and major systematic dysfunction⁶. It is a mixture of parenchymal alveolar disease (emphysema) and small-airway disease (obstructive bronchiolitis) and the FEV1/FVC less than 0.7 shows that the airflow limitation is not completely reversible⁷, ⁸.

According to the American Thoracic Society/European Respiratory Society procedure report on respiratory rehabilitation, increasing the accessibility of pulmonary rehabilitation is an important concern⁹. Physiotherapy is an integral part of the management of COPD patients and high-frequency chest wall oscillation technique (HFCWO) and airway clearance techniques (ACT) are harmless procedures in patients with COPD¹⁰.

Physiotherapy rehabilitation (PR) has been evidenced to be effective in increasing exercise tolerance¹¹. PR includes HFCWO yields compression of the rib cage wall through blowup sheath connected to air thump generator¹². HFCWO creates a cough-like expiratory flow bias that enhances mucociliary transport and removes secretions from alveoli, bronchi, and bronchioles.¹³⁻¹⁵. Exercise therapies support the recovery after an acute exacerbation in COPD patients¹⁶. Intrapulmonary percussive device (IPV) could be effective in COPD patients¹⁷.

Physiotherapy improves the quality of life, reduces breathlessness, and increases exercise tolerance through therapeutic exercises\(^8\). Conventional chest physical therapy (CPT) is a combination of huffing, coughing, percussion, shaking, vibration, and postural drainage, which is effective in mucus clearance in chest diseases\(^9\). Aerobic exercises also improve exercise tolerance in obstructive patients\(^10\).

There are few numbers of studies to find out the effects of chest physiotherapy in COPD patients and rigorous review on the effects of chest physical therapy (CPT) is still scarce. Therefore, this systematic review aims to evaluate the effects of manual and mechanical chest physiotherapy among patients with COPD and bronchiectasis.

**MATERIALS AND METHODS**

A systematic review was conducted on randomized controlled trials that assessed the effects of PR in obstructive patients. The review was conducted in consideration to follow the guidelines as defined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement\(^4\). All grading of COPD plus Spirometrically defined finding of COPD reliable using GOLD principles and bronchiectasis patients (forced expiratory volume in 1: forced vital capacity [FEV1: FVC] <70\%)\(^22\) were used. CPT (HFCWO and manual chest physiotherapy) was used as an intervention which was to compare CPT versus control (or usual care, pharmacological therapy, vibratory sensation, and chest physiotherapy. Spirometry, mMRC dyspnea scale, Borg dyspnea scale, St. George respiratory questionnaire (SGRQ), and 6MWT were used as outcomes. Only Randomized Controlled trials RCTs) were included. Studies that ensured a huge proportion of missing data and implemented insufficient numerical analysis, not in English or else translated and Studies beyond 2011 were excluded from this systematic review. Six electronic databases such as Google Scholar, Medline, BioMed Central, CINHAL, and Cochrane were reviewed in March 2021. Medical subject headings (MeSH) terms included “COPD”, “HFCWO”, “mMRC dyspnea scale”, “spirometry”, St. George respiratory questionnaire” and “pulmonary rehabilitation” were used. “AND” Boolean logic operator was used for a combination of terms. Titles and/or abstracts were reviewed and those articles not meeting eligibility criteria were excluded. The remaining articles were read in detail and considered according to PRISMA guidelines.

Initial screening was carried out by two authors (F.H. and H.A.S.). Then the detailed evaluation of full text and analysis against inclusion and exclusion criteria was performed by two viewers (F.H. and A.A.). The primary search sought a total of 152 studies, some studies were not freely accessible and others were irrelevant. Finally, the trials included in this review met the eligibility criteria on the effects of CPT on obstruction, dyspnea, and quality of life in obstructive patients. The information like author, year of publication, sample size, target population, intervention applied, frequency, and outcome measures were extracted from included trials. The risk of bias was evaluated using the Cochrane tool\(^23\). It evaluates biases in various manners, which include random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete outcome data, and selective reporting.

**RESULTS**

Selection of studies

The searches generated over 152 studies and subsequent screening of titles and abstracts, 80 complete articles were reviewed. Subsequently the complete analysis procedure 25 studies were considered appropriate for inclusion. Out of 25 studies, 15 eligible RCTs were included in the systematic review.

Ten studies were omitted because some articles were irrelevant, some were not available in English, some full texts were not available and some methodological quality was not good. A total of 15 RCTs were analyzed in this review\(^24\). Figure 1 shows the PRISMA flow diagram of the selection strategy of the trials. The RCTs included in this review comprise a total sample size of 1831 and investigated the effects of exercise therapies on obstruction, dyspnea and/or quality of life in obstructive patients. The trials published from 2011 to 2020 are included in this review.

The sample size of a study related to the effects of standard physical therapy on obstruction in COPD was 54, which lacks sample size calculation. However, the study used spirometry to measure obstruction\(^25\) (Table 1). The sample size of the two studies related to the effects of mechanical chest physical therapy on dyspnea in COPD was 90. However, the study used the mMRC dyspnea scale to measure dyspnea\(^27\) (Table 1). The sample size of the four studies related to the effects of manual and mechanical chest physical therapy on quality of life in COPD was 192. However, the study used SGRQ to measure the quality of life\(^29\) (Table 1).

The sample size of the two studies related to the effects of manual and mechanical chest physical therapy on both obstruction and dyspnea in COPD was 160. However, the study used spirometry and SGRQ to measure obstruction and dyspnea\(^30\) (Table 1). The sample size of the six studies related to the effects of manual and mechanical chest physical therapy on both dyspnea and quality of life in COPD was 1,335. However, the study used mMRC dyspnea scale or Borg dyspnea scale and SGRQ to measure dyspnea and quality of life\(^26\) (Table 1). Data extraction and quality assessment Chronic obstructive pulmonary disease: COPD; Acute exacerbation of chronic obstructive pulmonary disease: AECOPD; Exper-
Effects of Different Exercise Therapies on Obstruction, Dyspnea, and Quality of Life in COPD Patients: A...
<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Participants</th>
<th>COPD</th>
<th>EG 1</th>
<th>EG 2</th>
<th>CG</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicolini A et al.</td>
<td>2018</td>
<td>60</td>
<td>COPD</td>
<td>14 days/2 times in a day /15 min / session received physiotherapy and IPV</td>
<td>14 days/2 times in a day/20 min/ session received percussive device physiotherapy and HFCWO</td>
<td>Treated with physiotherapy alone</td>
<td>mMRC Dyspnea scale; SGRQ; mMRC dyspnea scale</td>
</tr>
<tr>
<td>Varas AB et al.</td>
<td>2018</td>
<td>33</td>
<td>COPD</td>
<td>A community-based 8-week program consisting of exercise training</td>
<td></td>
<td>Recommendations to walk more every day</td>
<td>mMRC dyspnea scale</td>
</tr>
<tr>
<td>Silva CM et al.</td>
<td>2018</td>
<td>51</td>
<td>COPD</td>
<td>8 weeks/3 sessions/week received warm-up, aerobic exercise, inspiratory muscle training, three sets of upper limb resistance exercise, stretching and followed by a massage</td>
<td></td>
<td>Received warm-up, aerobic exercise, inspiratory muscle training, and stretching followed by a massage</td>
<td>6MWT and SGRQ</td>
</tr>
<tr>
<td>Schultz K et al.</td>
<td>2018</td>
<td>602</td>
<td>COPD</td>
<td>3 weeks received highly intensive inspiratory muscle training</td>
<td></td>
<td>Received sham inspiratory muscle training</td>
<td>6MWD and SGRQ</td>
</tr>
<tr>
<td>Gurudut P et al.</td>
<td>2019</td>
<td>33</td>
<td>COPD</td>
<td>Group 1: Calisthenics</td>
<td>Group 2: Yoga</td>
<td>Group 3: Chest Physiotherapy</td>
<td>Modified Borg scale and SGRQ</td>
</tr>
<tr>
<td>Shamakh M et al.</td>
<td>2020</td>
<td>60</td>
<td>COPD</td>
<td>Group 1: 6 months received ACBT’s</td>
<td>Group 2: ACBT’s plus PEP</td>
<td>Group 3: ACBT’s plus Acapella</td>
<td>Quality of life</td>
</tr>
</tbody>
</table>

Chronic obstructive pulmonary disease: COPD; Acute exacerbation of chronic obstructive pulmonary disease: AECOPD; Experimental group: EG; Control group: CG; High-frequency chest wall oscillation: HFCWO; Positive expiratory pressure: PEP; Neuromuscular electrical stimulation: NMES; Intrapulmonary ventilation: IPV; Saint George respiratory questionnaire: SGRQ; Modified medical research council: mMRC; 6-minute walking distance: 6MWD; Forced expiratory volume: FEV

**Table 2: Author judgments regarding the risk of bias assessment**

<table>
<thead>
<tr>
<th>Domains</th>
<th>Random sequence generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants and personnel</th>
<th>Blinding of outcome assessment</th>
<th>Incomplete outcome data</th>
<th>Selective reporting</th>
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</thead>
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<tr>
<td>Mahajan AK al., 2011</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Tang CY et al., 2012</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cross JL et al., 2012</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Nicolini A et al., 2013</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Oeadnik CR et al., 2014</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Pradella CO et al., 2015</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Maddock M et al., 2016</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Farag TS et al., 2017</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Khan W et al., 2018</td>
<td>Y</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Nicolini A et al., 2018</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>X</td>
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<td>Y</td>
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</tbody>
</table>
DISCUSSION

This systematic review has critically analyzed RCTs conducted over the past 10 years (2011-2020) to assess the effects of different exercise therapies on obstruction, dyspnea, and quality of life in obstructive patients. The review consists of 15 trials with a total sample size of 1831 obstructive patients.

A study conducted by Mahajan AK et al. that HF-CWO significantly improved dyspnea in COPD patients because it is easy to use for obstructive patients and no need for assistance in mechanical chest physiotherapy, so it will be used by obstructive patients itself to relieve their obstruction, dyspnea and quality of life. Tang CY et al. reported that standard physical therapy is effective in the management of COPD to improve their exercise capability and improvement in activities of daily living.

Cross JL et al. conducted a study that manual chest physiotherapy has no part in controlling COPD symptoms because it’s difficult for the patient to visit a daily hospital for manual chest physiotherapy that’s why obstructive patients did not prefer manual chest physiotherapy. Nicolini A et al. conducted a study that HFCWO with traditional chest physiotherapy revealed a substantial improvement in lung capacities and volumes as well as in ADLs.

In contrast, Osadnik CR et al. study proved that positive expiratory pressure (PEP) has no part in controlling COPD symptoms such as dyspnea, sputum and cough because the device only creates positive pressure and assists expiration it has no role in mucus clearance and dyspnea Pradella CO et al., a study found that home-based pulmonary rehabilitation improved quality of life in COPD patients.

Maddock M et al. conducted a study that neuro-muscular electrical stimulation to quadriceps muscle enhanced efficient exercise capability and recovery from disuse atrophy of lower limb muscles Farag TS et al. study concluded that HFCWO and Flutter device is highly effective in the treatment of patients with AECOPD in terms of improvement in ventilatory function and oxygenation parameters with better exercise tolerance.

Khan W et al. analysis shows that chest physiotherapy with standard medical treatment has beneficial effects in pain management and quality of life but it requires the expertise of therapist and when family members apply chest physical therapy that’s why it has no such good effects. Nicolini A et al. conducted a study that HFCWO and IPV are also effective in the management of COPD patients Varas AB et al. study shows that community-based exercise training has useful effects in improvement of quality of life Silva CM et al. conducted a study that shows positive expiratory pressure is effective in improvement of pulmonary functions.

Schultz K et al. study shows that inspiratory muscle training has no effects on quality of life and dyspnea Gurudut P et al. study shows that yoga, chest physiotherapy, and calisthenics are equally effective in improvement of quality of life Shamakh M et al. study conducted a study that shows positive expiratory pressure is effective in improvement of pulmonary functions.

Compare with review from Alvarenga et al. that HFCWO technique is effective in COPD patients and this

Fig 1: Flow chart according to PRISMA strategies

Fig 1: Flow chart according to PRISMA strategies

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**TABLE**

<table>
<thead>
<tr>
<th>Study Authors and Year</th>
<th>Obstruction</th>
<th>Dyspnea</th>
<th>Quality of Life</th>
<th>PEP</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varas AB et al., 2018</td>
<td>✔</td>
<td>✔</td>
<td>❌</td>
<td>❌</td>
<td>✔</td>
</tr>
<tr>
<td>Silva CM et al., 2018</td>
<td>✔</td>
<td>✔</td>
<td>❌</td>
<td>❌</td>
<td>✔</td>
</tr>
<tr>
<td>Schultz K et al., 2018</td>
<td>✔</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Gurudut P et al., 2019</td>
<td>✔</td>
<td>✔</td>
<td>❌</td>
<td>❌</td>
<td>✔</td>
</tr>
<tr>
<td>Shamakh M et al., 2020</td>
<td>✔</td>
<td>✔</td>
<td>❌</td>
<td>❌</td>
<td>✔</td>
</tr>
</tbody>
</table>

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**Diagram**

Fig 1: Flow chart according to PRISMA strategies
study has similar results to our study because mechanical chest physical therapy produces vibrations to clear mucus and secretions and helps in the expiration of air that relieves dyspnea and ultimately improves the quality of life in obstructive patients.

One of the strengths of this review is focusing on the use of RCTs (2011 to 2020) with valid and reliable instruments to measure outcomes.

Further high-quality studies with the latest manual and mechanical intervention are needed to clearly understand which type of chest physiotherapy is most effective to achieve a better outcome in the management of obstructive patients and what will be the dose of exercise in obstructive patients.

CONCLUSION

High-to-moderate evidence supports that mechanical chest physical therapy is effective in the improvement of obstruction, dyspnea, and quality of life in COPD patients. HFCWO alone or in combination with standard physical therapy, traditional chest physiotherapy, and flutter device relieve mucus and secretions that help in the expiration and ultimately improves dyspnea and quality of life in obstructive patients and mechanical chest physical therapy requires visits and expertise and patients used by their self while on the other side manual chest physical therapy and home-based pulmonary requires visits and expertise which limit the therapist to continue their pulmonary rehabilitation, so it’s feasible for the obstructive patients to use mechanical chest physical therapy to relieve their symptoms and improve quality of life.

REFERENCES

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AUTHOR’S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Hussain F: Concept, design of study and manuscript writing

Shaikh HA: Data Collection

Ahmed A: Reviewing and Editing

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.