Original Article

Effects of Pulmonary Rehabilitation and Respiratory Muscle Training in Individuals with Acute Respiratory Distress

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Abstract

Background: Acute Respiratory Distress Syndrome (ARDS) arises from accumulation of fluid in the tiny, flexible air sacs of the lungs. Individuals with ARDS may experience muscle weakness, due to a condition known as intensive care unit acquired weakness, resulting in impaired physical function. To mitigate potential complications namely muscle weakness and joint contractures, and to assist with weaning from mechanical breathing and enhance the overall quality of life for individuals with ARDS, early rehabilitation is strongly advised.

Purpose: To compare the effectiveness of pulmonary rehabilitation and respiratory muscle training against conventional care among individuals with ARDS.

Materials and Methods: 30 subjects diagnosed with ARDS were randomly selected from the intensive care unit or patient ward of Saveetha Hospital following certain inclusion and exclusion criteria. The subjects were allocated into pulmonary rehabilitation with respiratory muscle training group (n=15) and conventional care group (n=15). The effectiveness of the treatments was assessed at the end of 4 weeks using a 30 seconds sit-to-stand test and St. George's Respiratory Questionnaire.

Results: Descriptive and inferential statistics were used to examine the data collected. All parameters underwent analysis employing mean and standard deviation. To analyze significant differences, pre-test and post-test measures, a paired t-test was performed. P values < 0.0001 were deemed statistically significant.

Conclusion: The combination of pulmonary rehabilitation and respiratory muscle training offered an adjunctive treatment option for patients with ARDS, providing quality of life, and improving strength of the muscle activities compared to conventional care alone.

Key Word: Acute distress respiratory syndrome, Pulmonary rehabilitation, Dyspnoea, Physical performance test, Quality of life

Introduction

Acute Respiratory Distress Syndrome is a progressive type of respiratory failure that involves extreme hypoxia and non-hydrostatic pulmonary edema[1]. Pathologically, diffuse alveolar injury, alveolar capillary leakage and the emergence of protein-rich pulmonary edema are the characteristic features of ARDS. All these factors adhere to the emergence of clinical manifestations such as dyspnea,

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decreased lung adherence, severe hypoxemia, and widespread bilateral infiltrates on chest radiographs[2]. A prevalence investigation was carried out over four weeks in 459 ICUs in fifty nations. Twenty-three percent of mechanically ventilated patients and ten percent of all ICU patients met the necessary standards, and the incidence of ARDS in the ICU was 5.5 million cases per ICU bed per year. Sepsis, pneumonia, aspiration of gastric contents, severe trauma, and numerous transfusions account for a significant number of instances of ARDS development among the various causes that have been identified[3].

Refinements in mechanical ventilator support have been provided recently in the treatment of ARDS, alongside a focus on protective lung ventilation approaches that use minimal minute ventilation, increased Positive End Expiratory Pressure (PEEP), and recruitment techniques to reopen collapsed lung alveoli[4]. Physical therapy for ARDS patients attempts to lessen their reliance on ventilators, improve their remaining lung function, regain their physical independence, limit complications, and improve their quality of life[5]. Chest manipulations, such as vibration, percussion, and suctioning (both open and closed procedures), have been included in basic physiotherapy interventions. Additionally, positioning is used to increase ventilation-perfusion mismatch, enhance ventilation-associated pneumonia incidence, and maximize oxygenation. In addition, active or passive mobilization is used to stop deconditioning[6]. Therefore, this study has been proposed to improve the quality of life and muscle strength in individuals with ARDS.

Aim

To compare the effectiveness of pulmonary rehabilitation and respiratory muscle training against conventional care among individuals with ARDS.

Material and Method

30 subjects with acute respiratory distress syndrome between the ages of 40 to 60 years were randomly selected from Saveetha Medical College and Hospital, Chennai to participate in an experimental study conducted to evaluate the effectiveness of pulmonary rehabilitation and respiratory muscle training compared to conventional care.

Inclusion Criteria:

- Both genders – Male and Female
- Age – 40 to 60 years
- Stable medical condition with a stable respiratory status, allowing for active participation in a rehabilitation program
- Patients diagnosed with moderate ARDS. (100mmHg < Pao_2/Fio_2 ratio ≤ 200 mmHg with PEEP ≥ 5cm H_2O)
- Sufficient cognitive and psychological ability to comprehend and actively engage in the rehabilitation process.

Exclusion Criteria:

- Unstable medical conditions, such as active infection or unstable respiratory status.
- Severe comorbidities or medical conditions.
- Cognitive impairment or psychological conditions.
- Cardiovascular instability, such as severe heart failure or unstable angina.
- Unwillingness or inability to comply with the requirements of a pulmonary rehabilitation program.

Outcome Measure

Assessments were done before and after the 4-week trial period.

- Physical performance: 30 seconds sit-to-stand test.
- Dyspnea- NYHA Classification
- Health related quality of life questionnaire: St. George's Respiratory Questionnaire (SGRQ)

Procedure

30 individuals diagnosed with ARDS were randomly selected from the intensive care unit or patient ward of Saveetha Hospital following certain inclusion and exclusion criteria. Study procedure was explained in detail to the participants and their willingness to participate was obtained by informed consent which was signed by the individual or their attender. The subjects were split into two groups and those assigned to the control group received conventional (standard) care while the subjects in the experimental group received pulmonary

rehabilitation and respiratory muscle training. The groups were treated according to the treatment protocol, which was followed for 4 weeks on 5 days/ week for 45 minutes per session.

Pulmonary Rehabilitation and Respiratory Muscle Training Group

- Step up, Step down holding two, 2kg dumbbell (10 rep's x 2 sets)
- Wall squats holding two, 2kg dumbbell (10 rep's x 2 sets)
- Calf raise down holding two, 2kg dumbbell (10 rep's x 2 sets)
- Leg lifts with two, 2kg weight cuffs (10 rep's x 2 sets)
- Shoulder press holding two, 2kg dumbbells (10 rep's x 2 sets)
- Chest press holding two, 2kg dumbbells (10 rep's x 2 sets)
- Elbow flexion and extension holding two, 2kg dumbbells (10 rep's x 2 sets)
- Walk short repetitive distance (50 meters' x 5 rounds)
- Positive expiratory pressure breathing technique (10 rep's x 2 sets)
- Pursed lip breathing technique (10 rep's x 2 sets)
- Coughing techniques- huffing and autogenic drainage (10 rep's x 2 sets)

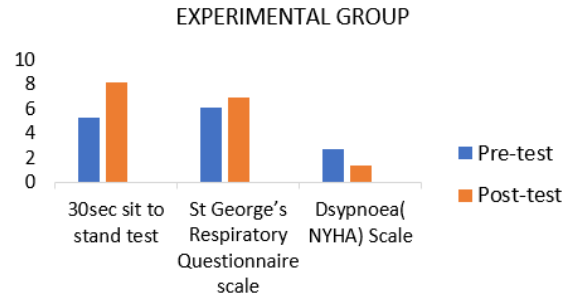
Conventional Care Group

- Deep breathing exercise (10 rep's x 2 sets)
- Hip flexion and extension with two, 2kg weight cuffs (10 rep's x 2 sets)
- Hip abduction and adduction with two, 2 kg weight cuffs (10 rep's x 2 sets)
- Knee flexion and extension with two, 2 kg weight cuffs (10 rep's x 2 sets)
- Ankle dorsiflexion and plantar flexion with two, 1kg weight cuffs (10 rep's x 2 sets)
- Shoulder flexion and extension with two, 2 kg dumbbells (10 rep's x 2 sets)
- Shoulder flexion and abduction with two, 2 kg dumbbells (10 rep's x 2 sets)
- Elbow flexion and extension with two, 2 kg dumbbells (10 rep's x 2 sets)
- Wrist flexion and extension with two, 1kg dumbbells (10rep's x 2 sets)
- Walking short repetitive distance (50 meters' x 5 rounds)

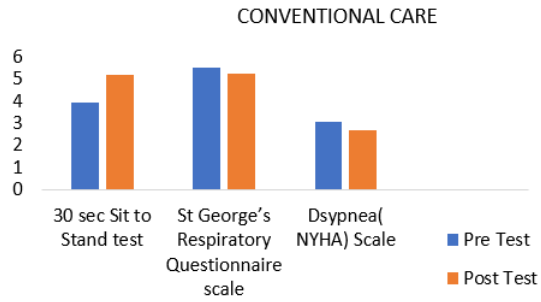
Treatment protocol

- Duration of the session: 45 minutes
- Frequency: 5 days a week / 4 weeks
- Sets: 2 sets
- Repetitions: 10 repetitions
- Rest: 1 min break between sets

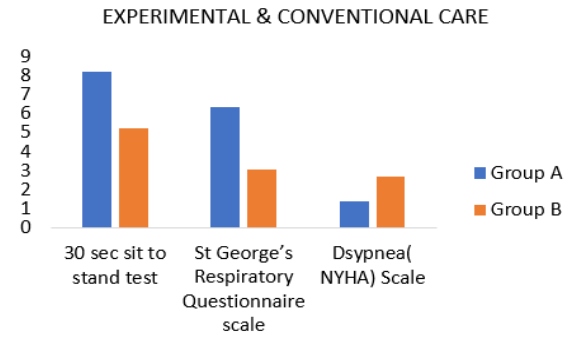
Data analysis



INTERPRETATION: Graph 1: Pre-test and Post-test values within the Experimental group



INTERPRETATION: Graph 2: Pre-test and Post-test values within the Conventional care group



INTERPRETATION: Graph 3: Comparison of Post-test Values between Experimental and Conventional care group.

Result

- The Experimental group's 30-second Sit-to-Stand test had pre-test mean values of 5.33 and post-test mean values of 8.20, with a P value of <0.0001. The St. George's Respiratory Questionnaire scale's pre-test mean value for the Experimental group was 6.133; the post-test mean value was 6.927. As a result, the results were revised and given a P-value of <0.0001 to reflect their statistical significance. The pre-test mean value of the dyspnea (NYHA) scale in the experimental group is 2.73, while the post-test mean value is 1.40. Therefore, with a P value of <0.0001, the findings were considered statistically significant.
- The Conventional Care Group's Sit-to-Stand test had pre-test mean values of 3.93 which increased to 5.20 in post-test with a P value of <0.0001. The pre-test mean value of St George's Respiratory Questionnaire scale in the Conventional Care group was 5.523 which decreased to 5.232 in post-test. Therefore, the findings are considered statistically significant with a p-value <0.0005. The pre-test mean value of the dyspnea (NYHA) scale in the experimental group is 3.07, while the post-test mean value is 2.67. With a P value of 0.0086, the findings were therefore considered statistically significant.
- With a P value of <0.0001 the post-test mean value of 30 sec sit to stand test in conventional care Group was 5.20 which is increased to 8.20 in Experimental group. The post-test mean value of St George's Respiratory Questionnaire scale in the conventional care group is 5.123 which is increased to 6.322 in the Experimental Group with the P value of <0.0001. In the Experimental group, the post-test mean value of the dyspnea (NYHA) scale is 1.40, and in the Conventional care group, the value is 2.67. With a P value of <0.0001, the results are therefore considered statistically significant.

Discussion

ARDS is a severe lung condition that affects both gas exchange and lung compliance. It is characterized by acute lung injury leading to respiratory failure, which requires mechanical ventilation in most cases. Conventional care for ARDS patients typically involves mechanical ventilation and supportive care, such as fluid management and nutrition.

Siddiq MA et.al, have explored the potential benefits of adding pulmonary rehabilitation (PR) and respiratory muscle training (RMT) to conventional care for ARDS patients[7]. Likewise, in this study Pulmonary rehabilitation helped enhance physical function by incorporating exercises that promote muscle strength, endurance, and overall physical conditioning. McNarry MA, Berg RM et.al, found, when compared to conventional treatments alone, pulmonary rehabilitation therapy with respiratory muscle exercise improved physical performance, decreased dyspnea, and enhanced quality of living in patients with post-ARDS[8]. Magadle R,et. al, results suggest that pulmonary rehabilitation with respiratory muscle training may be a valuable addition to conventional care in this patient population. However, in further studies techniques such as energy conservation strategies, and pacing techniques should be included to help alleviate dyspnea and reduce fatigue, allowing patients to perform daily activities with greater ease. According to Asadi-Lari et.al, the current objective for patients is not just to ensure their survival but also to achieve an optimal quality of life outcome[10]. For a patient, six weeks after being discharged, the improvement in exercise capacity may have been influenced, at least in part, by participating in a pulmonary rehabilitation program. The findings indicate a rapid recovery of exercise capacity during the early stage following hospital discharge in ARDS survivors. Impaired quality of life and exercise capacity were significantly associated with reduced pulmonary function. Among people who had recovered from ARDS, the anomalies in pulmonary function were associated with a deterioration in health-related aspects of life, particularly in areas pertaining to physical well-being.

Schelling et.al, found that patients with greater abnormalities on pulmonary function tests experienced the lowest health-related quality of life[11]. Additionally, Vinan-Vega et al. reported that pulmonary rehabilitation has the potential to enhance exercise capacity, sleep quality, alleviate depression, and promote healthy lifestyle[12]. Ramírez-Sarmiento

A et.al, demonstrated the advantages of respiratory muscle conditioning and pulmonary rehabilitation in patients with COPD and other respiratory illnesses[13]. However, this study is one of the first to specifically examine the effects of pulmonary rehabilitation with respiratory muscle training in patients post-ARDS. The improvement in physical performance and reduction in dyspnea observed in this study can be attributed to the strengthening of respiratory muscles and improvement in lung function that occurs with pulmonary rehabilitation and respiratory muscle training[14].

Eades M, Murphy J,et.al, the improvement in quality of life may be related to the reduction in dyspnea and improvement in physical function, as well as the psychological benefits of rehabilitation[15]. The study had several limitations, including a small sample size, a brief study period, and limited generalizability of the findings. The results of this study need to be confirmed by other research with larger sample numbers and longer follow-up timeframes. Candan SA, et.al, suggests that pulmonary rehabilitation with respiratory muscle training may be a valuable addition to conventional care in patients with post-ARDS[16]. This intervention may improve physical performance, reduce dyspnea, and improve the patient's level of well-being in this population. The implications of these findings hold significance in the clinical management of individuals after experiencing ARDS[17]. This study suggests that pulmonary rehabilitation with respiratory muscle training is effective in improving physical performance, reducing dyspnea, and improving quality of life in patients with ARDS. This suggests that these findings significantly impact the clinical management of ARDS as compared to conventional therapy alone. These findings warrant further research since they have major implications for the beneficial management of ARDS.

Conclusion

The combination of pulmonary rehabilitation and respiratory muscle training offered an adjunctive treatment option for patients with ARDS, providing improved lung function, quality of life, strength of the muscle activities compared to conventional care alone. Significant improvement was seen in the intra-group comparison of both groups from baseline to post 4-weeks intervention, as measured by 30 sec sit to stand test, St George's Respiratory Questionnaire scale and dyspnoea (NYHA) scale. The important aspect being any form of intervention is more necessary for an ARDS patient than no intervention at all. Further research needs to be done to determine the effectiveness as well as the safety of the following combination in the management of ARDS.

Ethical clearance: The study was approved by the committee of institutional scientific review board. All study participants were informed about the study objectives, and those who agreed to Participate signed informed consent forms.

Funding: None

Conflicts of interest: The authors declare that they have no conflicts of interest.

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