Effect of Respiratory Muscle Training on Respiratory Muscle Strength and Functional Capacity on Hemiparetic Patients

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Abstract:

BACKGROUND: Respiratory muscle weakness is commonly found in neurologicalpatients and respiratory strength can be found out using the Maximum Expiratory Pressure, Maximum Inspiratory Pressure and functional capacity with Six Minute Walk Test.

OBJECTIVE: To find out respiratory muscle training over respiratory muscle strength and functional capacity in hemi paretic patients.

METHODOLOGY: Study design Quasi-Experimental, study type pre and post-test type. Inclusion criteria: both men and women were included, Age 40-65.Exclusion criteria: recent fracture and surgeries. The samples are collected about 14 according to inclusion and exclusion criteria. Samples are analysed with Respiratory Pressure Meter and Six Minute Test.

RESULTS: This results shows respiratory muscle strength and functional capacity has improved in 6-week training protocol.

CONCLUSION: From this study it is concluded that respiratory muscle training is effective for improving the respiratory muscle strength and functional capacity in hemi paretic patients.

Keywords: **Respiratory Pressure Meter, Maximum Inspiratory and Expiratory Pressure, Six minute walk test**.

I. INTRODUCTION

STROKE is a major cause of disability among adults worldwide and has an incidence of about 252 per 100,000 people. The Prevalence of stroke is about 27% of total population, among which 20% is caused by ischemic, the remainder being caused by haemorrhage. The mortality rate is higher in Indonesia in the world. Risk factors includes older age, hypertension, recurrent stroke attacks, diabetes mellitus, hyperlipidaemia, smoking and atrial fibrillation. High blood pressure is the one of the most important modifiable risk factor[1].

Stroke is classified into ischemic and haemorrhagic, ischemic is caused by blockage of blood supply and haemorrhagic by the rupture of blood vessels[2].

Hemiparesis is a condition associated with stroke, which means partial weakness of one side of the body. It may be right or left side of body weakness according to the site of injury to the brain. Paralysis of one side of the body is due to lesion/injury present in opposite side of brain. Brunstorm classification is used to assess the type of the muscle tone. Initially patient undergoes with flaccidity of muscles and later on spasticity develops[3].

Among the most frequent observed deficits in post stroke individuals, muscular weakness stands out, which was also observed in the respiratory muscles and may compromise the respiratory function of these individuals [4].

Some respiratory problems have been identified immediately after the stroke during the acute and subacute period, such as sleep disorders, altered ventilator patterns, and risk of aspiration. However, neurological rehabilitation approaches to chronic Stroke Survivors (SS) rarely take into account of assessment and treatment of respiratory muscles[4].

A literature review carried out in 2011 showed that patients with chronic hemiplegia/hemiparesis after a stroke have limitations in their static and dynamic volumes and present respiratory muscle alterations and concluded that these responses should be considered during patient rehabilitation. Few studies published in the past 10 years have assessed strength of respiratory muscle, gauging maximal expiratory pressure (MEP) and maximal inspiratory pressure (MIP). A decrease in maximal expiratory pressure in patients with hemiplegia has been related to lack of trunk control, whereas a lower value of maximal inspiratory pressure has been correlated with a decrease in gait speed[5].

The respiratory system is controlled by three functional components: (1) sensory receptors that provide information about the respiratory system (2) the central circuits; and (3) the motor output of respiratory muscle[6].

Decline in respiratory function have been shown to be independent predictors of coronary and cardiovascular mortality and mobility. In addition, respiratory muscular weakness, when associated with changes of the chest wall motions, could be related to reduced tidal volume (TV) and exercise tolerance[6,7].

Weakness and strengthening of the peripheral muscles have been often investigated in stroke subjects. Despite the lack of studies that investigated the cardiopulmonary parameters in hemiparesis, the impact over

the functional capacity of hemiparesis can be manifested. Focal destructive hemispheric lesions results in contralateral dysfunction of the ventilator muscles. **Fluck (1992)** observed a reduction in chest wall movements when patient took voluntary deep breath[8].

Walking ability is the functional limitation found in stroke patients associated with poorer community integration and improving functional capacity and mobility of the patient is a key role of stroke rehabilitation.

Exercise endurance tests such as Six Minute Walk Test (6MWT) helps to assess people with cardio-respiratory disease. This test is used to measure the walking endurance among Stroke Survivors (SS).

This study aims to assess the effect of training on respiratory muscle and exercise tolerance among hemi paretic patients.

II. AIM OF THE STUDY

The main aim of the study was to find out the effect of respiratory muscle training on respiratory muscle strength and functional capacity on hemi paretic patients

III. NEED FOR THE STUDY

Only few studies are available on respiratory muscle training and 6-minute walk test for hemi paretic patients. The impact and importance of respiratory training in hemi paretic patient's needs more supportive literature. To our knowledge only a few studies were available to support the respiratory training that too only negligible studies available in Indian population. The purpose of the study was to show the need and importance of respiratory training among hemi paretic patients and the essential of pulmonary rehabilitation in stroke treatment protocol to improve functional outcomes. So this study was done to widen the knowledge and extend the stroke rehabilitation protocols for the benefit of the patient and to improve their quality of life.

IV. METHODOLOGY

STUDY DESIGN: Quasi-Experimental Design,

STUDY TYPE: Pre and Post type,

SAMPLING METHOD : Convenient Sampling,

SAMPLING SIZE: 14 subjects,

STUDY DURATION: 6week,

STUDY SETTING: SRM Medical College Hospital and Research Centre, SRM University. Kattankulathur, And home based physiotherapy in and around Chennai

INCLUSION CRITERIA

Patients included with diagnosis of hemiparesis ≤ 2 months (both sides) according to BRUNNSTROM RECOVERY STAGES (III, IV, and V)

Age between: 40-65 years.

Both males and females are included.

Patients who were receiving neurological rehabilitation treatment; were able to walk with or without assistance (assistive device, orthotic device, and/or physical aid from another person);

Subjects who were able to understand instructions for several tests.

Patients with Ischemic stroke were included.

EXCLUSION CRITERIA

Pulmonary diseases.

Cardiovascular diseases.

Have undergone thoracic or abdominal surgery in previous 3months.

Spinal deformities.

Recurrent stroke.

Epileptic attacks.

Psychological disorders.

MATERIALS USED

Respiratory pressure meter

Respiratory threshold device

Mouth pieces

Disinfectant (spirit)

Stop watch

Two small cones to indicate the turning points

A movable chair

Meter Tape

Sphygmomanometer

Colour tape

Stethoscope

PROCEDURE

Patients who satisfy the inclusion and exclusion criteria were recruited for the study. An informed consent was obtained prior to the commencement of the study. All the participants were undergone with a standardized interview about their demographic, clinical characteristics and rehabilitation procedure details.

Vital signs (temperature, blood pressure, heart rate, respiratory rate) was assessed before and after the Maximum Inspiratory and Expiratory Pressure and functional capacity during pre-test and post-test measurements.

Respiratory muscle strength was checked by using "RESPIRATORY PRESSURE METER" (Maximum Inspiratory Pressure and Maximum Expiratory Pressure). The procedure was demonstrated before the performance is done by the patient. Functional Capacity was checked by "6-MINUTE WALK TEST". Before starting, clear instructions with verbal encouragement has been given while participating.

"INSPIRATORY MUSCLE TRAINER" was used to train the inspiratory muscle for 6 weeks [3 sessions/week], i.e. on alternative days. Initial training was started with $1/3^{rd}$ of maximum Inspiratory and Expiratory Pressure respectively.

Breathing exercises, chest wall mobilisation exercises were encouraged on the remaining 3 days/week. After each week the respiratory pressure was checked for providing more resistance than initial for training. At the end of 6 weeks duration the respiratory muscle strength and functional capacity are assessed for post-test values.

V. RESPIRATORY STRENGTH-RESPIRATORY PRESSURE METER

Patient is positioned in sitting, using the respiratory pressure meter the maximum inspiratory pressure and maximum expiratory pressure has been checked. After a deep expiration, the inspiration is done immediately for the inspiratory pressure and the values are noted. The expiratory pressure was calculated, after a deep inspiration and the values were noted. The mouth pieces for both the pressure meter are provided separately. Each time before and after usage of procedure the mouth pieces are washed using spirit (disinfectant). After every week the respiratory strength was measured for increasing the resistance of training.

VI. FUNCTIONAL CAPACITY-6 MINUTE WALK TEST

The 6-Minute Walk Test was performed in indoor, along a flat, straight, enclosed hospital corridor. The walking course of 30 meter in length, i.e. 100-ft hallway. The length of corridor of 60 meter from beginning to end line are marked of 3 meter each with the help of cone. Demonstration of the test was given to the patient, and asked to start walking. The patients were asked to sit in a chair for at least 10 minutes which is located at the beginning point.

Patients were instructed to walk from starting to end line at their own speed, and to cover as much distance allotted in 6 minutes. Patients were advised to stop and rest when in need but, they can continue walking within 6 minutes. The walking time and the number of laps covered by the patients at the end of the study will be recorded.

After the walk, heart rate and blood pressure is measured. If the walking is stopped while performing the test, the reason behind is noted down. The total distance covered by the patient is calculated by

Number of laps + final partial lap(meters)=total distance walked in 6minute (meters)

VO2 max=(0.03xsix minute distance(in meters)+3.38 (men)

VO2max=(0.06x six minute distance(in meters)+3.38 (women)

VII. RESPIRATORY MUSCLE TRAINING

The patient inhales through a resistive training device, placed in the mouth. Inspiratory resistive training devices have narrow tubes with different diameters which provides resistance for inspiration and expiration for improving strength and endurance to respiratory muscles. The smaller the diameter of airway, the greater the resistance.

*Inpiratory Muscle Training***:** After the Maximum Inspiratory Pressure is found, the initial resistance of 30% from MIP is added to the Inspiratory Threshold Device for training the inspiratory muscles.

*Expiratory Muscle Training***:** After the Maximum Expiratory Pressure is found, the conventional method of Inspiratory Threshold Device is used with a resistance of 30% from MEP is given for training the expiratory muscles. The procedure was repeated 10 times, 2-6 sets and rest-1minute.The resistance was changed according to the respiratory pressure improvement.

VIII. OUTCOME MEASURES

Respiratory Muscle Strength – Maximum Pressure of inspiration, Maximum Expiratory Pressure

Functional Capacity – Six Minute Walk Test

IX. CONCLUSION

This study concludes that there is significant increase in respiratory muscle strength and functional capacity among hemi paretic patients after the respiratory muscle training for a period of six weeks. This study also recommends to include the respiratory muscle training in the rehabilitation protocol to improve the patient's quality of life.

X. LIMITATIONS

- The limitations of the study was hemiparesis patients with more than 2 months were not included, only few sessions of training has been given in a week.
- Only ischemic stroke patients have been recruited.
- Not enough space to conduct 6 Minute Walk Test in home based physiotherapy.

XI. RECOMMENDATIONS

- Further research can be done on other neurological patients.
- Training sessions can be increased with larger sample size for better results.
- Patients with hemorrhagic stroke can also be taken into study.
- Duration of the study can be reduced for short-term effects.