Effect of threshold inspiratory muscle trainer along with abdominal in-drawing maneuver for weakness of respiratory muscles in hemiplegia

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Abstract: **subjects with common disabilities of stroke survivors, motor weakness is the most prevalent and disabling. Hemiplegia is the most common and is the primary indication for rehabilitation. Consequences of hemiplegia may include abnormalities in muscular tone, as well as postural and motor control that lead to inadequate functioning of the entire body and could compromise voluntary motor function. It also compromises core strength which affects the normal functioning of respiratory muscles leading to respiratory insufficiency. This insufficiency causes dyspnea which indirectly reduces functional capacity of the individual leading to decreased quality of life. Thereby this study is proposed to determine the effect of threshold inspiratory muscle trainer along with abdominal in drawing maneuver for respiratory muscle weakness among hemiplegia. Methods and Measures: 16 patients with hemiplegia were selected based on the inclusion and exclusion criteria and were randomly allocated into 2 groups. Group A and Group B, Group A was treated with respiratory muscle training along with abdominal in drawing maneuver. Group B was treated with respiratory muscle training. Both the group patients were tested for (FEV1), (FVC), (MVV) using spirometer and Dyspnea scored using Borg scale as a pretest and after which patients were given stroke rehabilitation for 40 minutes and respiratory muscle training for 20 minutes per session per day for five days per week for a total period of 4 weeks following which outcomes were tested for posttest same as of pretest. Result: In comparison between the mean values of group A and group B, group A was found to be effective than group b with p value <0.001 which is considered as statistically significant. In comparison within the group, both the groups showed significant difference between pre-test and post-test values. Conclusion: Therefore, it is concluded that threshold inspiratory muscle trainer along with abdominal in-drawing maneuver is effective in improving forced expiratory volume, forced vital capacity and maximum voluntary ventilation in hemiplegia.**

Keywords: respiratory muscle weakness, hemiplegia, threshold inspiratory muscle trainer, abdominal in drawing maneuver, FEV1 (Forced expiratory volume per second), FVC (Forced vital capacity) , MVV (Maximum voluntary ventilation)

I. INTRODUCTION:

Stroke is defined by the World Health Organization[1] as 'a clinical syndrome consisting of rapidly developing clinical signs of focal (or global in case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin.[1] A transient ischemic attack (TIA) is defined as stroke symptoms and signs that resolve within 24 hours.[2] There are limitations to these definitions.[3] The symptoms of a TIA usually resolve within minutes or a few hours at most and anyone with continuing neurological signs when first assessed should be assumed to have had a stroke. 'Brain Attack' is sometimes used to describe any neurovascular event and may be a clearer and less ambiguous term to use.[4]

Abnormalities of posture, muscle tone, and motor control of voluntary movement, and reduced participation of trunk muscles, can affect motor abilities and respiratory muscle activities Stroke resulting in weakness of these muscles can lead to cardiopulmonary volume adjustments and lack of oxygen, which can disrupt cardiovascular conditioning and the oxygen transfer system.[5] This state can cause stroke patients, who require intensive rehabilitation, to tire easily during aerobic activities that require endurance, thereby restricting performance of activities of daily living.[6]Inspiratory muscle training (IMT) for improvement in respiratory function involves the application of a load to the diaphragm.[7] Auxiliary inspiratory is reported to improve muscle strength and endurance. The basic principles of skeletal muscle strengthening were applied to the overload, specificity, and reversible.[8] the respiratory system on stroke patients depends on the structures affected by the lesion. The maintenance of normal respiration depends on the intact functional components of the neuromuscular system.[9] Ventilator disturbances occur when the diseases affect the nervous system, the muscle routes or the thoracic cage, despite the lungs being normal.[10] The loss of selectivity of the trunk muscle groups, which occurs in stroke patients, means that they become unable to stabilize their column in the erect position.[11] Normally, the deep abdominal (transverse abdominal; TIA, internal oblique; IO) muscles, in coordination with the deep multifidus muscle, play a central role in lumbar spinal stiffness, contributing to core stability. The TIA muscle is preferentially activated to maintain postural stability in the motor control of the trunk muscles during limb movement.[12]

The secondary problem caused by a stroke is the decrease in the rib cage activity and the electrical activity by the result of the muscles disuse and the limited activity. In addition the problem causes the decrease in the cardiorespiratory control and the capacity of the oxygen transfer system, and consequently, it creates the oxygen debt resulting in the weakness of aerobic exercise capacity affecting the cardio-pulmonary function.[13]The pulmonary function weakness significantly affects the maintenance of life, and it is an essential element to be maintained for improving the physical function and the quality of life in stroke patients. In

addition, the cardio-pulmonary function affects the trunk control which does an important role in the maintenance of standing position, body movements, balance and stability required for activities of daily living[14].

II. NEED OF THE STUDY

To determine the effectiveness of threshold inspiratory muscle trainer along with abdominal in drawing maneuver for respiratory muscle weakness among hemiplegia.

III. METHODOLOGY

Study design: experimental study

Study setting: Saveetha Medical College & Hospital,
Physiotherapy outpatient department,
Saveetha University, thandalam,
Chennai – 602105

Sampling method: convenient sampling

Sample size: 16 subjects

2.1 Inclusion criteria: Subjects of age group – 35 to 55 years, Subjects of both genders, Hemiplegic subjects with medullary pontine lesion, Subjects with apnea and ataxic breathing with 3months post onset.

2.2 Exclusion criteria: Subjects were excluded if they had previous musculoskeletal abnormalities, confusion, neurological disorders, significant perceptual, cognitive, or communication impairments and subjects who had chronic obstructive pulmonary disease and asthma.

2.3 PROCEDURE:. 16 patients with hemiplegia were selected based on the inclusion and exclusion criteria and were randomly allocated into 2 groups. Group A and Group B, Group A was treated with respiratory muscle training along with abdominal in drawing maneuver. Group B was treated with respiratory muscle training. Both the group patients were tested for (FEV1), (FVC), (MVV) using spirometer and Dyspnea scored using Borg scale for pre-test and after which patients were given stroke rehabilitation for 40 minutes and respiratory muscle training for 20 minutes per session per day for five days per week for a total period of 4 weeks following which outcomes measures were tested for post-test same as of pretest

Materials required: Threshold inspiratory muscle trainer.

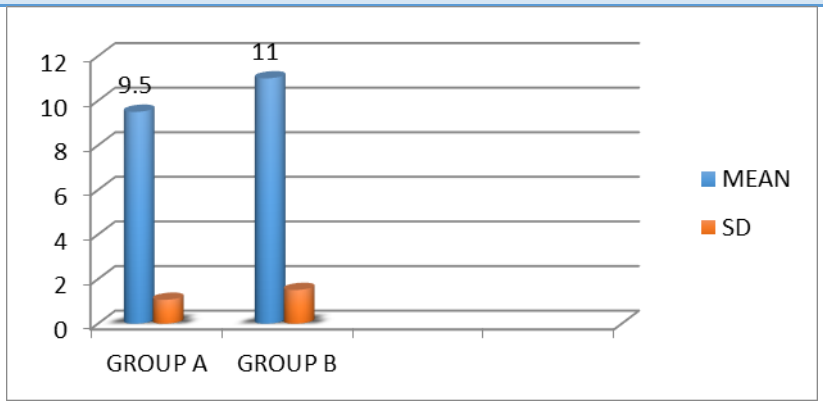
Outcome measures:

Borgs scale, Pulmonary Function Test

IV. STATISTICAL ANALYSIS:

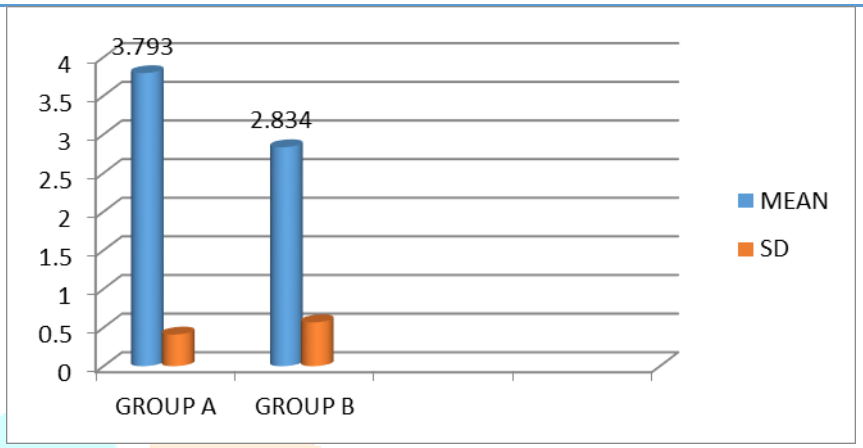
Comparison of Dyspnea score within Group A and Group B

Group	Mean		Standard Deviation		t value	p value
	Pre test	Post test	Pre test	Post test		
Group A	13.00	9.50	1.51	1.07	6.5479	0.0003
Group B	13.38	11.00	1.69	1.51	5.1575	0.0013



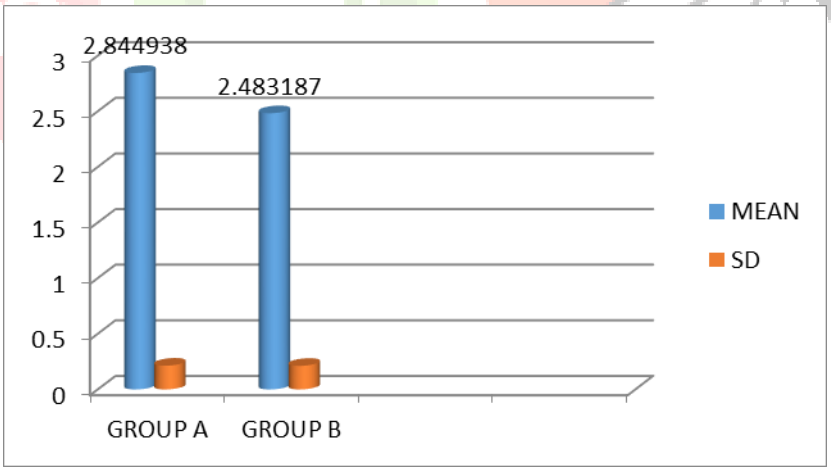
Comparison of Forced expiratory volume in one second (FEV1) within Group A and Group B

Group	Mean		Standard Deviation		t value	p value
	Pre test	Post test	Pre test	Post test		
Group A	1.96838	3.7930	0.58007	0.40984	9.8880	0.0001
Group B	2.20975	2.8340	0.70858	0.56762	4.9828	0.0016



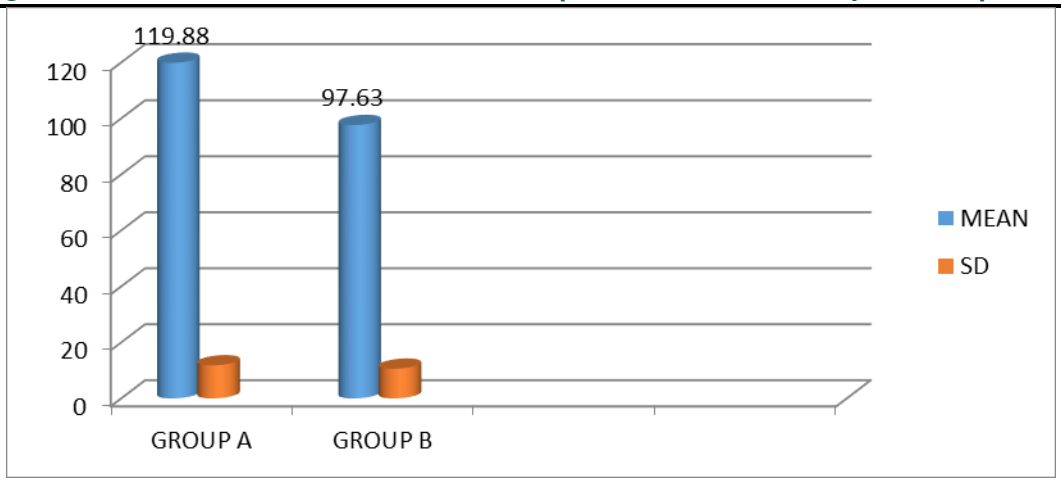
Comparison of forced vital capacity (FVC) within Group A and Group B

Group	Mean		Standard Deviation		t value	p value
	Pre test	Post test	Pre test	Post test		
Group A	2.279200	2.844938	0.23176	0.213704	4.1860	0.0041
Group B	2.069837	2.483187	0.48419	0.211969	2.6217	0.0343



Comparison of maximum voluntary ventilation (MVV) within Group A and Group B

Group	Mean		Standard Deviation		t value	p value
	Pre test	Post test	Pre test	Post test		
Group A	96.00	119.88	10.93	11.81	7.2765	0.0002
Group B	88.38	97.63	14.37	10.60	2.7203	0.0298



Comparison of post-test results between group A and group B

	GROUP A	GROUP B	t value	p value
Borg scale	9.50	11.00	2.2913	0.0380
MVV	119.88	97.63	3.9658	0.0014
FEV1	3.79300	2.83400	3.8743	0.0017
FVC	2.844938	2.483187	3.3993	0.0043

V. RESULT

In comparison between the mean values of group A and group B, group A was found to be effective than group b with p value <0.001 which is considered as statistically significant. In comparison within the group, both the groups showed significant difference between pre-test and post-test values.

VI. DISCUSSION

This study compares the pre-test and post-test effects of the Threshold Inspiratory Muscle Training (TIMT) and Abdominal In-drawing Maneuver (AIDM) in stroke patients. The before-after intervention study, after four-week application of TIMT and AIDM showed the improvement of FEV1, FVC and MVV in both groups. Group A was given TIMT and group B was given

The expansion and contraction of the lungs are affected by the capacity of the thoracic cage, and determined by skeletal mobility, the elasticity of adjacent soft tissues, and the strength of respiration muscles.[8] In the case of stroke patients, the hypertension of trunk and the asymmetric arrangement accompany.[10] Diaphragm, pelvic floor, and TrA control IAP and provide the stability of lumbopelvic posture. Such intrinsic spinal stabilization muscles provide spinal stiffness, in the cooperation with IAP, though which spinal dynamic stability is improved. When the spinal stabilization exercise is applied, the method of pushing the abdomen out through abdominal breathing is used.[12] This method can do the co-contraction of the diaphragm and deep stability muscles and increase the intra-abdominal pressure if the navel is maintained in a front-downward while the thoracic cage is not extended and the lower abdomen is expanded in the phase of inhalation.

The application of the ADIM in this study is carried out in the prone position using a pressure bio-feedback unit, which has been commonly considered to enhance the stability in the lumbo-pelvic region during lower and upper extremity exercises.12 The ADIM has been applied to adult patients with core muscle instability in the prone position, and it has been reported that the thickness of TIA and IOM increased. Another previous study also shows that the ADIM increases the abdominal deep muscle activity of TrA and ADIM, and that the increased muscle activity is observed in the group applied with ADIM.18

After a stroke, the ability of a patient to maintain trunk control in sitting and standing positions is a fundamental skill for achieving autonomy in activities of daily living. The trunk control performance of patients soon after a stroke has been found to be closely associated with long-term functional improvement.26 In the few weeks after stroke, there may be alterations to the muscular tonus and changes to the viscoelastic properties of muscles, causing contracture of the hemiplegic side, as well as rigidity of the competed thoracic, which interfere with the biomechanical functioning of the thorax and may lead to a loss in the ability and performance of the respiratory movements and trunk.27 One study shows that the Based on these results, various studies for enhancing lung functions should be conducted continuously.

Jandt et al.27 conducted a correlation study between respirator muscles, pulmonary function, and trunk control ability, and showed that the correlation (r= 0.426, p= 0.054) between the trunk impairment scale (TIS) and maximum inspiratory pressure is significant, but it is close to the level of significance. In addition, the correlation between TIS and maximum expiratory pressure is statistically significant. However, they showed that other indices of pulmonary function have nothing to do with trunk control, except the significant correlation between TIS and PEF. In this study, the change in the anterior mFRT in the groups of AEM and ADIM who do the breathing exercise is larger than the change of control group, and the change in the ADIM group shows statistically larger improvements compared with the control group. In addition, the change of PEF in the ADIM and AEM groups is larger compared with control group, which is following the results in the previous studies. This implies that, when a stroke

patient does respiration exercise, not only conducting ADIM is effective for the trunk control ability, but also AEM has effects on the trunk control ability.

Spinal stabilization exercise has been developed for functional activity, and it contributes to the efficient control of physical movement.30 Hand grip strength, which is a measure for forearm muscular strength, shows a high correlation with whole body strength, and the trunk muscles involved with the trunk stability affects not only the trunk movement but also the movement of legs and arms as a synergistic muscle.31

This study is carried out to suggest an efficient method for intervention of improving trunk stabilization, upper limb function, and pulmonary function. However, fifteen minutes as a duration of exercise is short to check the effects of the exercise, and there was a limitation in terms of accuracy in the breathing exercise through the AEM, while the breathing exercise using visual feedback through ADIM has been quantified. Therefore, future works for appropriate intervention period and the methodology for quantified AEM would be required.

VII. CONCLUSION:

Therefore, it is concluded that threshold inspiratory muscle trainer along with abdominal in-drawing maneuver is effective in improving forced expiratory volume, forced vital capacity and maximum voluntary ventilation in hemiplegia.

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CONFLICT OF INTEREST:

The authors declare no conflict of interest.

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