The Efficacy of Group Exercise Program on Improvement of Respiratory Function and Balance Ability in Local Community Patients with Chronic Stroke

Gi-Do Kim

Abstract

This study is intended to examine the efficacy of group exercise program on improvement of respiratory function and balance ability in local community patients with chronic stroke. To achieve this goal, this study selected 15 chronic stroke patients in local community. Experimental group (n=15) received group motivating exercise program which program was performed 5 weeks. The program included a therapeutic program to improve abdominal muscle strength and respiratory function. The respiratory functions were analyzed forced vital capacity (FVC), forced expiratory volume at one second (FEV$_1$) by spirometer. To measure balance ability changes, we measured berg balance scale (BBS). In respiratory function and balance ability test, the post outcome was improved than the pre outcome. Especially, FEV$_1$ and BBS showed significantly increased than pre (p<.05). The results of this study showed that the group motivating exercise program may be appropriate for improving the respiratory function and balance ability in local community with chronic stroke.

Keywords : Group Exercise, Respiratory Function, Balance Ability, Local Community, Chronic Stroke

1. Introduction

Stroke is a common nervous system disorder that occurs due to abnormal blood circulation in the brain with a completely developed nervous system. This disease becomes the cause of considerable morbidity and mortality worldwide [1]. As the survival rate of patients with stroke increased owing to advances in medical technology, stroke became the most common internal cause of disablement [2].

In general, stroke patients experience weakness of muscles on the affected side [3]. The trunk muscle is the biggest part of our body and plays an important role in the stabilization and movement of body segments. It also contributes to smooth central movement so that our body

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easily can be changed to new posture.

However, the weakness of trunk muscles moves the center of gravity backward, thereby causing thoracic bending. As this disturbs proper postural control by reducing the activation of abdominal muscles [4], it can become the primary cause of reduced balance and gait abilities [5]. Stroke patients employ abnormal postural control strategies while performing tasks due to the loss of postural control ability and physical imbalance [6], and they have their center of gravity moved toward the unaffected side. Therefore, they cannot perform symmetric weight bearing and have reduced limits of stability [7].

The weakness of trunk muscles in stroke patients also affects their primary and secondary respiratory muscles [8]. Therefore, it causes functional respiratory disorders which limit physical activities [9]. Damage to the motor cortex and the pyramidal tract due to a stroke leads to motor control disorders and co-contraction of trunk muscles due to abnormal levels of muscle tension and voluntary movement. As a result, the coordination and motor performance of respiratory muscles are impaired [10].

Thus, when planning the treatment for stroke patients, tests on their postural control ability and respiratory function should be considered as important factors to evaluate their functional abilities and determine their treatment and prognosis. Intervention programs to improve the postural control ability and respiratory function of stroke patients should focus on improving trunk stability. Trunk stability depends on coordinated activities of multiple trunk muscles, and therefore, these muscles should contract in a concerted manner to secure stability [11].

Core-stability is usually to strengthen the muscle around the abdominal, lumbar, and pelvic regions, because the muscles of these regions play an important role in stability as well as in controlling the lumbar posture by using tonic or postural muscles during whole-body exercise [12]. Core-stability is prerequisite for maintaining the proper posture of the lumbar and pelvic regions during activities.

Exercise for core-stability serve as treatment for simultaneously activating the abdominal and multifidus muscle in order to stabilize the body and head during the beginning of limb movement and during the course of these movements. [13] Stroke patients lack selective movement control and thus the order of muscle movement is changed. These patients thus move in an unusual pattern, which results in much waste of energy and malfunctioning movement pattern. Verheyden et al. [14] suggested that selective trunk stabilization exercises should be added to traditional exercise therapies to improve balance after a stroke.

This study was designed based on the results of previous studies demonstrated that the weakening of trunk muscle seen in chronic stroke patients causes disorders in postural control
and respiratory function.

The purpose of this study was to evaluate the efficacy of group motivating exercise program with a focus on strengthening trunk muscles, on the respiratory function and balance ability in patients with chronic stroke. Then, based on the results, the study intends to support the effectiveness of group exercise program for local community patients with chronic stroke.

2. Subjects and Methods

2.1 Subjects

The present study choose 15 subjects who consented study participation after hearing the objective of the study among those who local community patients with chronic stroke located in Hadong Gun in Korea. All patients signed an informed consent form. Experimental group received group motivating exercise program for abdominal muscle strength.

The selection conditions for subjects are follows:
1) No impairment of corrected vision and hearing.
2) Duration of disorder > 6 months.
3) Do not have any problem in musculoskeletal model.
4) Absence of a cardiac disorder.
5) Having MMSB-K score > 19.

2.2 Exercise Program

The present used exercise program that it is based on trunk stability exercise program (hollowing exercise, curl-up exercise, bridging exercise, dead bug exercise) developed by Kim [15]. The program was performed 60 min, 4 times a week for a period of 5 weeks. Group exercise program is a therapeutic program to train abdominal muscle strength and respiratory function using respiratory device.

2.3 Outcome assessment

The respiratory functions were measured forced vital capacity (FVC), forced expiratory volume at one second (FEV₁) with spirometer (microLab MK6 Sphrometer, Care Fusion232Ltd, UK). To observe balance ability changes, we measured balance and coordination ability with berg balance scale (BBS).
2.4 Statistical method

For the statistical analysis of this study, SPSS 18.0 ver. for window® was used. The results of all experiments were expressed as a mean and standard deviation. The comparison on
respiratory function change and balance ability of value paired t-test was used for the comparative verification on pre and post of exercise programs. If ‘p’ value is less than 0.05, statistical significance level was used.

3. Result

3.1 Changes of respiratory function

The experimental group was improved respiratory function, especially FEV1 showed significantly different between pre and post (p<0.05).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Changes of respiratory function in experimental group</th>
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<tbody>
<tr>
<td></td>
<td>FVC</td>
</tr>
<tr>
<td>Pre</td>
<td>2.13±0.44</td>
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<tr>
<td>Post</td>
<td>2.17±0.41</td>
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</tbody>
</table>

All values showed mean ± SD  Test by paired t-test (*p<0.05)

3.2 Changes of balance ability

The experimental group was improved balance ability, especially BBS 1, BBS 3, BBS 4 showed significantly different between pre and post (p<0.05).

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Changes of balance ability in experimental group</th>
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<tbody>
<tr>
<td></td>
<td>BBS 1</td>
</tr>
<tr>
<td>Pre</td>
<td>3.10±1.20</td>
</tr>
<tr>
<td>Post</td>
<td>3.90±0.32*</td>
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|         | BBS 3 | BBS 4 |
| Pre     | 2.20±1.25 | 0.90±0.45 |
| Post    | 3.00±0.94* | 2.20±1.32** |

All values showed mean ± SD  Test by paired t-test (**p<0.05)

- BBS 1: Standing unsupported with eye closed
- BBS 2: Retrieving object from floor
- BBS 3: Standing with one foot in front
- BBS 4: Standing on one leg

4. Discussion

Recent studies have focused on respiratory function and the balance ability of chronic stroke
patients because reduction in the motor control ability of muscles involved in breathing, due to the weakening of trunk muscles on the affected side, has been known to be associated with declines in thoracic movement and strength of respiratory muscles [16].

Chen et al. [17] reported that the lost strength of abdominal and thoracic expiratory muscles reduces the ability to effectively cough and remove sputum, which results in various respiratory complications due to the accumulation of secretions within the respiratory tract.

In other words, the weakness of trunk muscles in stroke patients affects their primary and secondary respiratory muscles and postural control ability. Therefore, it causes functional respiratory disorders which limit physical activities.

Since the 1990s, trunk stability training has been implemented as a therapeutic intervention to reduce pain and increase abdominal and lumbar stability, particularly for patients with chronic lumbar pain. In recent years, it has been suggested as an intervention to strengthen the trunk muscles of stroke patients.

Marshall and Murphy [12] reported that trunk stabilization training alleviates the imbalance of muscles necessary for postural maintenance by activating abdominal muscles and small vertebral muscles in a coordinated and simultaneous manner.

Considering these findings, this study evaluated an eight-week trunk stabilization training program as a method for strengthening the trunk muscles of chronic stroke patients intensively, and then analyzed its outcome by comparing the results with those of a general exercise therapy program aimed at improving balance and symmetry. Postural control ability refers to the trunk's anticipatory postural adjustment exhibited before the movement of the extremities [18]. Most patients with hemiplegia experience difficulties in this balance ability.

In this study, the result of balance ability test, Berg balance scale (BBS) test revealed that experimental group showed increased, especially BBS 1, BBS 3, BBS 4 showed significantly different between pre and post (p<.05). This suggests that group motivating exercise program may have positive effects on improving the balance ability of chronic stroke patients. The experimental group performed trunk stability exercise program that consisted of holding the stomach inward, lifting the trunk, and rotating the lower extremities. As the patients in experimental group strengthened their abdominal and lumbar muscles intensively, they were able to strengthen the trunk muscles and improve the control of selective muscle movements. In a previous study, Verheyden [14] implemented a five-week trunk exercise program in 33 stroke patients, and reported that the test group showed a statistically significant level of improvement in postural control ability compared to the control group that received general exercise therapy. Saeyns et al. [19] also reported in their study that trunk exercises were more
effective than general exercise therapy for stroke patients in terms of postural control ability, balance, and motor skills. Their findings support the results of this study.

The weakening of respiratory function is the most important issue in supporting the life of stroke patients. In addition, the accurate measurement of respiratory function is essential for evaluating the functional abilities of patients, diagnosing their diseases, and assessing their prognosis and degree of impairment, thereby allowing proper exercise prescriptions to be made. In this study, the result of respiratory function test, forced vital capacity (FVC) and forced expiratory volume at one second (FEVI) test revealed that experimental group showed increased. The above results may illustrate that group task-oriented exercise program also has positive effects on the respiratory function of chronic stroke patients by improving their trunk control ability. Bach et al. [20] supported the interpretation of the results of this study by arguing that abdominal and lumbar strengthening exercises improve expiratory function and thoracic expansion, thereby increasing forced expiratory volume. Lung capacity and forced expiratory volume are closely associated with the strength of respiratory muscles [21]. This study showed that a five-week group motivating exercise program applied in local community patient with chronic stroke had positive effects on their respiratory function and balance ability.

A comprehensive review of the above results suggests that when physical therapists aim to improve the respiratory function and balance ability of local community patients with chronic stroke, group motivating exercise program performed to strengthen trunk muscles through direct interaction with patient increases therapeutic efficiency and effects.

5. Conclusions

This study confirmed that a five-week group exercise program was effective in improving the respiratory function and balance ability of local community patients with chronic stroke. Therefore, the results of this study are likely to become essential information showing the effectiveness of group exercise program for the rehabilitation of local community patients with chronic stroke in clinical practice.
References


