A pilot study on the electrical stimulation for the abdomen to improve motor performance of the inactive elderly

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Abstract

Surface electrical stimulation (ES) for the abdomen was applied to the elderly people being admitted to an institute for nursing care. Due to chronic disuse they could not walk independently during 3 months before start of ES despite intervention with common physical therapy. ES was performed twice a day during 2months adding to physical therapy. Surface electrodes were put on the area of the bilateral abdominal oblique muscles. Before and 2 months after ES, we evaluated abdominal fat and muscle composition examined by Magnetic Resonance Imaging, grip strength, maximum walking speed, time of getting up, flexibility of the trunk, standing balance and the score of Functional Independence Measure (FIM).

As a result of ES, motor performance like walking and getting up and the level of ADL improved. Furthermore, muscle volume increased and fat volume decreased after ES in all of the subjects examined. The relationship between the change of abdominal soft tissue composition and the improvement of motor performance is unclear but the local change induced by ES may be one of triggers to improve general motor function.

1 Introduction

Strength of the trunk muscles declines easily with the process of aging and/or disuse, while such muscles have important roles not only for truncal function but also for whole body motor function. Training of the trunk to improve muscle strength is commonly applied to young healthy adults since overloads to the trunk of the elderly with some pathological state easily cause muscle and joint injury. Safe and efficient way of muscle reinforcement is required.

In the present study we applied electrical stimulation (ES) to the abdominal muscles of the inactive elderly people and investigated its local and general effects, i.e. change of abdominal soft tissue composition and motor performance.

2 Methods

Seven elderly people (3 males and 4 females) who were admitted to an institute for nursing care participated to this study. Mean age, mean height, mean weight, and mean BMI were as follows respectively: 74.0 (54~85) years, 150.4 (137.3~168.5) cm, 57.7 (37.9~76.9) kg, 25.4 (19.3~32.5) kg/m^2. Due to chronic disuse all of them had not been able to walk independently during at least 3 months before start of ES despite continuous intervention with common physical therapy. They had spent major part of a day in their bedroom. A portable electrical stimulator (Lintec prototype; Tokyo, Japan) was used for ES. The electrode for surface stimulation was 5*10cm (Lintec prototype; Tokyo, Japan). ES was performed twice a day during 2months with using a portable electrical stimulator adding to physical therapy.

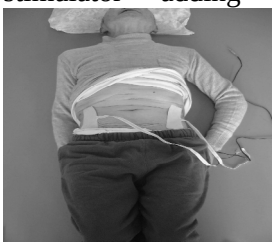

Fig. 1 position of the electrodes

Cyclic stimulation for 15min using bipolar rectangular pulses with 0.2msec duration was adopted and stimulation frequency was 30Hz. Stimulation electrodes were put on the muscle belly of the bilateral abdominal oblique muscles (Fig. 1). Stimulation intensity was set at the

maximum level under pain threshold. Before and 2 months after ES, we evaluated abdominal fat and muscle composition examined by Magnetic Resonance Imaging, grip strength, maximum walking speed, time of getting up on the bed, flexibility of the trunk, standing balance and the score of Functional Independence Measure (FIM).

Wilcoxon's signed rank test was used for statistical analysis.

3 Results

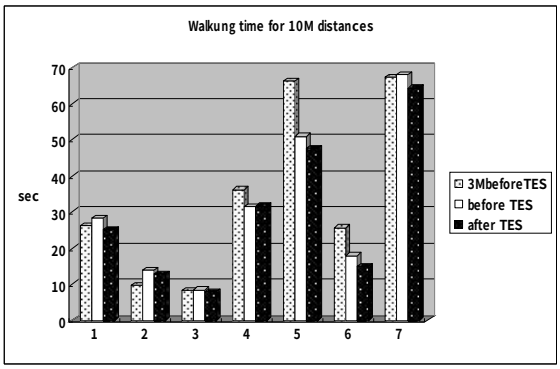

Fig. 2 Change of walking time before and after ES

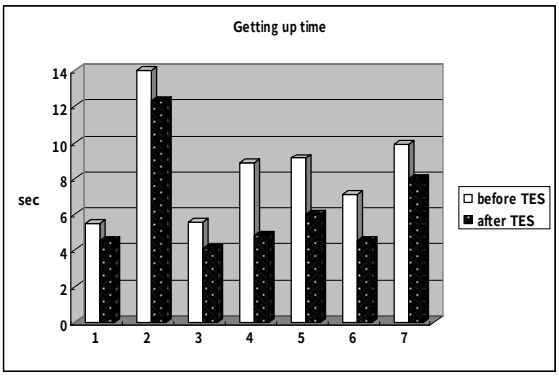

Fig. 3 Change of getting up time before and after ES

The time of walking for 10m distances significantly decreased from 31.3 ± 21.4sec (before ES) to 29.2 ± 20.5sec (after ES) ($p<0.05$) (Fig.2). The time of getting up on the bed also significantly decreased from 8.6 ± 2.9sec (before ES) to 6.3 ± 3.0sec (after ES) ($p<0.05$) (Fig.3).

Flexibility of the trunk measured by finger-toe distances in trunk bending, grip strength and the time of one leg standing in both sides did not show remarkable change.

Four subjects showed increase of FIM score after ES though the score did not show any changes during 3 months before ES in all of the subjects.

The volume of muscle and fat around the abdomen could be measured only in 3 subjects tentatively. All of them showed increase of muscle volume (24%, 34%, 57%) and decrease of fat volume (21%, 26%, 36%) after ES.

4 Discussion and Conclusions

Our study had two major findings. First, we found motor performance like walking and getting up improved after ES. Second, the result of this study suggested muscle volume might increase and fat volume might decrease after ES.

Furthermore, the level of ADL possibly elevates after ES because some patients showed increase of FIM score after ES though the score of FIM had been stable during 3 months before ES. The precise relationship between the change of abdominal soft tissue composition and the improvement of motor performance is unclear but the local change induced by ES may be one of triggers to improve whole body motor function.

References

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