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Original Article

Changes of Muscle Thicknesses of the Back Muscles in Lateral and Prone Position Using Ultrasonography

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Abstract. [Purpose] The purpose of this study was to compare the anterior-posterior (AP) diameter of back muscles measured in the lateral position to that measured in the prone position using ultrasonography. [Participants and Methods] The participants were 20 healthy elderly men over 65 years old (mean age, 71.4 ± 5.4 years). The AP diameter of the right multifidus muscle (L2) (LM (L2)), a multifidus muscle (L5) (LM (L5)), and the erector spinae muscles (ES) were measured on longitudinal images. The changes in the AP diameter in the lateral and prone positions were measured. [Results] The AP diameter of LM (L2) and ES increased significantly in the lateral position. There was no significant difference in the AP diameter of LM (L5) between the lateral and prone positions. [Conclusion] Care should be taken when measuring back muscles in the lateral position with ultrasonography, as increased muscle activity may alter the AP diameter.

Key Words: Ultrasonography, Back muscles, Lateral position

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1. INTRODUCTION

Previous research shows reduction in trunk muscle function is important, as follows: Verheyden et al[1)] proved that a stroke patient's reduction in trunk muscle function is strongly related to loss of balance, reduced walking, and associated functional activity. Ezure et al[2)] proved that a stroke patient's independence in daily life relates to function of the trunk rather than the hemiparetic limbs. Saito et al[3)] showed that in the sickly elderly, independence in daily life activity reduces as trunk muscle shrinks. Clinically, illness reduces trunk muscle strength; hence, in many of such cases, basic movement and activities are impeded. Therefore, it is important to evaluate and treat trunk muscle as part of rehabilitation.

The number of studies using ultrasonography to evaluate trunk muscle has increased in recent years. In these studies[4-6)], the back muscles were measured on longitudinal images obtained using ultrasonography. All the subjects were measured in the prone position. However, in the case of patients whose intravenous lines or nasogastric tubes require management during the measurement, the measurement itself may be difficult. Moreover, hyperkyphosis may develop in elderly patients, rendering the prone position impossible. In such cases, it is necessary perform measurements in the lateral position. Therefore, the purpose of this study was to clarify the difference in the anterior–posterior (AP) diameter of back muscles in the lateral and prone positions using ultrasonography.

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2. SUBJECTS AND METHODS

The participants were 20 healthy elderly men over 65 years of age. (mean age 71.4 ± 5.4 years, mean height 163.1 ± 6.8 ㎝, mean weight 62.6 ± 8.6 ㎏, mean body mass index (BMI) 23.5 ± 2.3 ㎏/㎡). Exclusion criteria were illness, injury, pain in the waist or abdomen, or previous lower back pain. Written consent was obtained from all participants.

The AP diameter of the right multifidus muscle (L2) (LM (L2)), a multifidus muscle (L5) (LM (L5)), and erector spinae muscles (ES) were measured on longitudinal images obtained using ultrasonography sonosite180plus (FUJIFILM SonoSite, Inc. Bothell, WA, US). Based on previous research, the AP diameter of LM (L2) and LM (L5) were measured at 2 cm outside of a spinous process of the second and the fifth lumbar vertebra, with the probe placed perpendicularly to the spinal column [7-10]. The AP diameter of the ES was measured at 5 cm outside of a spinous process of the third lumbar vertebra, with the probe placed perpendicularly to the spinal column [6, 10, 11]. The high-brightness region was not included in the measurement. Measurements were performed twice by stopping breathing at the end of exhalation. Calculation of each muscle AP diameter was performed from the pictures obtained using ImageJ (U.S. National Institute of Health). Each muscle AP diameter was measured twice. The average of two measurements was taken as a representative value. The postures during measurement were the prone and left lateral positions. In both postures, measurement was performed at the natural pelvic tilt. The left lateral position was maintained with 45-degree hip and 90-degree knee joint flexion. Excessive inclination of pelvis and lumbar was avoided. The measurements were performed by a physiotherapist with eight years of experience. The T-test was used to analyze the difference in AP diameter for each muscle. SPSS version 19.0 was applied for every analysis. The level of significance was 5%. This research was done in accordance with the Declaration of Helsinki. The purpose and details of the research were explained to the subjects beforehand. The measurements were made after consent was obtained. The protocol for the study was approved by the Ethics Committee of International University of Health and Welfare (17-IO-101) and Hospital, International University of Health and Welfare (13-B-262). There were no conflicts of interest in this research.

3. RESULTS

The value of each muscle AP diameter in the prone and left lateral positions is shown in Table 1. The AP diameter of LM (L2) and ES increased significantly in the left lateral, compared with the prone position. There was no significant difference in the AP diameter of LM (L5).

Table 1. Mean muscle thickness at prone position and lateral position (n=20)

	Prone position (㎜)	Lateral position(㎜)
LM(L2)	30.4 ± 4.6*	33.0 ± 4.6
LM(L5)	28.6 ± 3.6	29.7 ± 3.5
ES	31.8 ± 3.8*	32.4 ± 3.8

*：p＜0.05（vs Lateral position）

4. DISCUSSION

The purpose of this study was to clarify the difference in the AP diameter of back muscles in the lateral and prone positions using ultrasonography. It was found that in the left lateral position, muscle AP diameter increases significantly. It is thought that instability of postural muscles appears in the lateral position. The AP diameter of LM (L2) and ES increased significantly in the lateral compared with the prone position. However, the AP diameter of LM (L5) did not show a significant difference. This suggests that the lateral position causes muscle activity of LM (L2) and ES, but not LM (L5). In previous research into the question of whether muscle AP diameter reflects muscle activity, the validity of the theory was confirmed with electromyography. With regard to LM, the comparisons of muscle AP diameter between elbow extension and flexion, between shoulder adduction and abduction[12], and between quiet and vigorous expiration were previously confirmed[13]. The same is true for ES, where the comparisons were made between isometric contractions while adjusting the output in a sitting position. Therefore, it is regarded that the changes of muscle AP diameter in different postures are due to muscle activity. The reasons why activity of LM (L2) and ES, is needed in the lateral position are: The thoracic cage, which provides most support to the upper half of the body in the lateral position, is elliptical. Therefore, the contact surface with the ground is small, compared with the lower half of the body, and the center of gravity tends to deviate from the base of support. Muscle activity is needed to compensate for this. Furthermore, since ES is not directly attached to a lumbar vertebra, there is no stability of the muscle itself.

In the context of LM (L5), the left lateral position was maintained by hip joint flexion of 45 degrees and knee joint flexion of 90 degrees. Compared with the upper half of the body, the base of support of the lower half of the body is large. Therefore, the lower half of the body is stable, and the stability of the pelvis is maintained, so muscle activity of LM (L5) is unnecessary. Also, LM (L5) is partly adherent to the pelvis, in contrast to LM (L2).

A limitation of this study is that the AP diameter of trunk muscle does not necessarily indicate muscle activity. Many other elements are related to changes in muscle diameter. These are muscle length at rest, extensibility, structure, type of contraction, and the level of measurement, etc[14]. Devices and examination are required to reduce the influence.

It is suggested, when measuring back muscles of patients requiring intravenous fluid or nasogastric tube management, or have hyperkyphosis, and are in the lateral position, that the measurement should be considered in the context of this research.

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REFERENCES

1) Verheyden G, Vereeck L, Truijen S : Trunk performance after stroke and the relationship with balance, gait and functional ability. Clin Rehabil , 2006,20:451-458.
2) Aya Ezure, Shinichi Harada, Yusuke Ozawa, et al.: Relationship between Trunk Function and ADL of Hemiplegic Stroke Patients. Rigakuryoho Kagaku, 2010,25(1):147-150. (In Japanese)
3) Atsushi Saito, Tamotsu Matsubara, Takeshi Akimoto, et al.: The cross sectional area changes of the psoas, quadratus lumborum, paraspinal muscles with CT in frail elderly patients. Hospice and Home Care ,2012,20(1):36-41. (In Japanese)
4) Hitomi Ubukata, Ming Huo : Study on the Gender Difference of Lumbar Multifidus Cross-sectional Area Using Ultrasound System. Japanese Physical Therapy Association , 2014,41(5):301-305. (In Japanese)
5) Ai Yamamoto, Junya Miyazaki : Examination of the Inter-operator Reliability of Ultrasound Measures of Multifidus Muscle Echo Intensity . Rigakuryoho Kagaku, 2018,33(3):443-446. (In Japanese)
6) Stokes M, Hides J, Elliott J, et al.: Rehabilitative ultrasound imaging of the posterior paraspinal muscles. J Orthop Sports Phys Ther ,2007,37:581-595.
7) Teppei Abiko, Hitoshi Takei, Ryoya Shimamura, et al.: Reliability of Rehabilitative Ultrasound Imaging of the Lumbar Multifidus . Rigakuryoho Kagaku ,2011,26(5):693-697. (In Japanese)
8) Yoshiaki Endo, Ko Onoda, Akira Kubo : Difference in the Cross Sectional Area of the Right and Left Multifidus Muscle of the Waist at Each Lumbar Level. Japanese Physical Therapy Association, 2017,44:42-46. (In Japanese)
9) Yoshiaki Endo, Ko Onoda, Akira Kubo : Correlation between the Cross-sectional Area of the Multifidus Muscle at Each Vertebral Level and Body Composition. Rigakuryoho Kagaku, 2018,33(5):733-737. (In Japanese)
10) Yoshiaki Endo, Ko Onoda, Akira Kubo : Changes in Muscle Thicknesses of the Trunk Muscles with Posture . Rigakuryoho Kagaku ,2017,32(4) : 527-530. (In Japanese)
11) Yoshihiro Fukumoto, Noriaki Ichihashi , Yosuke Yamada : Assessment of Muscle Quantity and Quality with Ultrasonography .Japanese Physical Therapy Association ,2015,42:65-71. (In Japanese)
12) Kiesel KB, Uhl TL, Underwood FB, et al. Measurement of lumbar multifidus muscle contraction with rehabilitative ultrasound imaging. Manual Ther 2007;12:161–166
13) Djordjevic O, Konstantinovic L, Miljkovic N, et al. Relationship between electromyographic signal amplitude and thickness change of the trunk muscles in patients with and without low back pain. The Clinical journal of pain. 2015;31(10): 893-902.
14) Hodges PW. Ultrasound imaging in rehabilitation: just a fad?. J Orthop Sports Phys Ther. 2005;35(6): 333-337.