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Original Article

# Effects of manual lymph drainage for abdomen on the brain activity of subjects with psychological stress

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**Abstract.** [Purpose] The present study investigated the effects of manual lymph drainage for abdomen on electroencephalography in subjects with psychological stress. [Subjects and Methods] Twenty-eight subjects were randomly allocated to undergo a 20-min session of either manual lymph drainage or abdominal massage on a bed. [Results] Analysis of electroencephalograms from the manual lymph drainage group showed a significant increase in relaxation, manifested as an increase in average absolute, relative alpha activity and a decrease in relative gamma activity. [Conclusion] Our results suggest that the application of manual lymph drainage from the abdomen provides acute neural effects that increase relaxation in subjects with psychological stress.

**Key words:** Manual lymph drainage, Abdominal massage, Psychological stress

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## INTRODUCTION

Psychological stress occurs when a person perceives environmental demands beyond his or her adaptive capacity[1)]. Generally, stressful events affect the occurrence of a physical disease via affective states such as anxiety and depression[1)]. Long-term exposure to chronic stress can be extremely harmful since it causes long-term or even permanent changes in several emotional, physiological, and behavioral responses that in turn affect disease development[3)]. Therefore, alleviating stress is of utmost importance. Stress continuously increases sympathetic tone, and various measures are currently used to relieve excessively elevated brain activity. Among them, massage is frequently used to alleviate symptoms including muscle spasm, pain, and depression[2, 4, 5)]. However, research on its use in alleviating elevated sympathetic tone and brain activity is lacking. Among various massage techniques, abdominal massage is reported to be effective at easing constipation and relieving sympathetic tone[2, 6–10)]. Emly reported that abdominal massage eased constipation during physical therapy in patients with cerebral palsy[11)]. Additionally, other researchers have agreed that abdominal massage is effective for decreasing abdominal spasticity[6, 12)]. Abdominal massage (AB) is also reported to help reduce sympathetic tone.

Manual lymph drainage (MLD), a technique developed by the physical therapist Dr. Vodder, is used as an effective measure to treat lymphedema that may develop after treatment of cancers like breast or gynecological cancers[13–16)]. Recently, a number of studies have been conducted to evaluate its effects on muscle relaxation, pain relief, and the autonomic nervous system[17, 18)]. There has been a study to evaluate changes in brainwaves[19)] and brain activity[20)] after MLD; however, MLD was only applied to the neck area and this was just a preliminary study. To our knowledge, until now no study has evaluated

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**Table 1.** Homogeneity test for general characteristics the subjects at baseline

| Variable | Group | |
|---|---|---|
| | MLD (n=14) | AM (n=14) |
| Age (yrs) | 22.3 ± 1.3 | 21.9 ± 1.6 |
| Gender (Male/Female) | 3/11 | 2/12 |
| Height (cm) | 162.8 ± 3.5 | 163.2 ± 4.5 |
| Weight (kg) | 59.4 ± 7.4 | 60.2 ± 6.1 |
| Body mass index (kg/m$^2$) | 21.4 ± 5.0 | 21.2 ± 1.3 |

MLD: manual lymph drainage; AM: abdominal massage

the effects of abdominal MLD on brain activity. Therefore, our study aimed to investigate the effects of MLD and abdominal massage on brain activity in subjects with psychological stress.

## SUBJECTS AND METHODS

The study enrolled 94 subjects. They were selected according to the following inclusion criteria: 1) not currently taking any medication that may affect the EEG signal; 2) no history of mental illness; 3) free of heart disease; 4) free of dermatologic, gastrointestinal, and cardiovascular disease. All subjects completed the stress response inventory (SRI) to evaluate their responses to stressful situations (e.g., emotionally, cognitively, somatically, or behaviorally)[21]. The reliability[21] of the SRI was between 0.76–0.97. Based on the questionnaire results, 30 subjects with an SRI score>80 were enrolled, comprising 6 male and 24 female subjects. However, 2 of them dropped out because of personal issues. The remaining 28 subjects were randomly allocated to MLD and AM groups. All test protocols were approved by the ethics committee of the Physical Therapy Faculty of Kangwon National University. All subjects participated voluntarily and provided written informed consent.

All procedures were conducted in a darkroom, with an average room temperature of 22–24 °C. Subjects lay supine on a massage table, with their hips flexed at 70° and their legs placed on a wedge-shaped pillow in order to help with muscular relaxation of the whole body. During the experiment, conversation, phone calls, noises, and electromagnetic waves that may act as variables were blocked to minimize peripheral stimulation. Subjects were asked not to sleep but to open their eyes.

The study protocol was as follows. The subject took 10 minutes of rest before the experiment to adapt to the study environment and to stay calm. Electroencephalography (EEG) was performed for 5 minutes before and after the massage. The massage was done for 20 minutes with either the MLD or AM technique.

The MLD was applied according to Dr. Vodder's Manual Lymph drainage: a practical guide[22]. Stroke category (type) and time of each stroke were standardized so that they could be applied identically to every subject. The procedure was as follows. Neck massage: effleurage →cervical lymph node →occipital area →mandible →fork technique; shoulder massage: shoulder/ trapezius muscle →shoulder/ acromion →cervical lymph node→effleurage; abdominal massage: rotary technique from the pubic bone to the sternum →Solar plexus →descending colon →triangular stroke in the three colonic directions →'L shaped' massage in the three colonic directions →horizontal rotary below the navel →abdominal lymph nodes→final effleurage with breathing.

A typical Swedish abdominal massage program was developed by a massage specialist so that it could be applied identically to all subjects. The procedure was as follows: pressing vertically and horizontally relative to the navel (4 directions) →circular stroke in clockwise direction →sweeping down in diagonal direction below costal margin →sweeping down in the direction of the colon →pinching the flank towards the navel →sweeping down from the costal margin to below the navel →clockwise circular stroke, using the fingertips superior, inferior, right, and left of the navel →vibration near the sigmoid colon →pressing vertically and horizontally relative to the navel (4 directions) →circular stroke in a clockwise direction and sweeping from the costal margin down to the navel (repeat 3 sets).

Data collected from 18 EEG channels were analyzed with the TeleScan software package (LAXTHA, Daejeon, South Korea). Electrodes were placed in accordance with the 10–20% international standard. Since subjects were lying in a supine position, electrodes at the occipital lobe (F19–21) were omitted. Ground and reference electrodes were placed on both zygomatic bones, overlapping the MLD profundus massage positions. Brain waves were measured in a quiet place. A warm environment was maintained, and the light was blocked out to help subjects relax. Data are expressed as mean ± SD values. All variables were tested for normality using the one-sample Kolmogorov-Smirnov test and did have a normal distribution. The unpaired t-test was used to test for homogeneity and the unpaired t-test was used to compare the MLD and AM groups results for differences in EEG. The collected data were analyzed using a statistical package program (SPSS ver. 21.0). A two-tailed probability of $p<0.05$ was considered statistically significant.

**Table 2.** Average absolute EEG subband power distribution of all channels

| Type | | Pre | Post |
|---|---|---|---|
| γ ($\mu V^2$) | MLD | 1.62 ± 0.40 | 1.53 ± 0.97 |
| | AM | 1.70 ± 0.53 | 1.61 ± 0.46 |
| θ ($\mu V^2$) | MLD | 3.42 ± 0.51 | 3.72 ± 0.42 |
| | AM | 3.33 ± 0.44 | 3.42 ± 0.31 |
| α ($\mu V^2$) | MLD | 2.42 ± 0.37 | 2.83 ± 0.51* |
| | AM | 2.51 ± 0.65 | 2.64 ± 0.56 |
| β ($\mu V^2$) | MLD | 2.52 ± 0.34 | 2.23 ± 0.54 |
| | AM | 2.49 ± 0.57 | 2.42 ± 0.36 |

All variables are means ± standard deviation.
MLD: manual lymph drainage; AM: abdominal massage
*p<0.05

**Table 3.** Average relative EEG subband power distribution of all channels.

| Type | | Pre | Post |
|---|---|---|---|
| γ | MLD | 0.19 ± 0.05 | 0.16 ± 0.03* |
| | AM | 0.18 ± 0.03 | 0.17 ± 0.08 |
| θ | MLD | 0.51 ± 0.07 | 0.53 ± 0.08 |
| | AM | 0.54 ± 0.05 | 0.57 ± 0.09 |
| α | MLD | 0.18 ± 0.03 | 0.22 ± 0.05* |
| | AM | 0.17 ± 0.09 | 0.18 ± 0.05 |
| β | MLD | 0.08 ± 0.04 | 0.09 ± 0.04 |
| | AM | 0.07 ± 0.05 | 0.08 ± 0.03 |

All variables are means ± standard deviation.
MLD: manual lymph drainage; AM: abdominal massage
*p<0.05

## RESULTS

There was no statistically significant difference between the MLD and AM groups in general characteristics or brainwaves (p>0.05, Tables 1, 2 and 3). The post-MLD average absolute alpha rhythm was significantly higher in the MLD group (p<0.05, Table 2). The MLD group also had a significantly higher relative alpha power and a lower relative gamma power than the AM group (p<0.05, Table 3).

## DISCUSSION

The purpose of this study was to investigate the effects of MLD and abdominal massage on acute brain activity in subjects with psychological stress.

MLD on the neck and abdomen and general AM were both shown to promote relaxation. In particular, post-MLD and AM measurements showed an increased average absolute, relative alpha rhythm, and decreased average absolute, relative beta and gamma rhythm. Moreover, the MLD group had statistically higher activity in the alpha and gamma rhythms than in abdominal massage. Alpha waves are dominant under relaxed conditions, whereas beta wave becomes dominant under excited conditions. Gamma waves are found during the excitation, anxiety and psychological stress stage[23]. Our finding of reduced cortical arousal through MLD may also be explained by the findings of other studies[24, 25]. This concurs with the results of a study by Shim and Kim[19], in which applying MLD on the neck resulted in higher alpha and delta activity compared to resting alone. Our results imply that MLD and AM reduce excitation in people with stress, thereby alleviating their stress. The fact that application of MLD on the neck and abdomen results in higher alpha and gamma activity than does application of AM indicates that it is a better method to relieve tension and induce psychological relaxation.

Previous studies have reported that MLD promotes relaxation of brain activity[19] and reduces sympathetic tone[17]. These reports support results of our study, in which application of MLD on the neck and abdomen reduced cortical arousal of people under stress.

Our study was an investigation of acute electrophysiological changes observed when MLD and AM are applied to people with psychological stress. However, the limitation of our study is that it does not reveal long-term effects. Further studies are required to investigate this aspect. In order to improve the replication of results, more subjects should be enrolled and more rigid control of the testing environment is required. Additionally, we were unable to include a control group for rest alone. Future studies should consider including this control group, evaluating other diseases, and applying diverse MLD techniques.

In conclusion, MLD and abdominal massage are both effective at changing psychological state of people with stress to a more restful state. In particular, applying MLD on the neck and abdomen is effective in reducing brain arousal. Thus, MLD can be considered a treatment for people with psychological stress.

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