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Effects of Manual Lymph Drainage of the Neck on EEG in Subjects with Psychological Stress

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Abstract. [Purpose] The present study investigated the effect of manual lymph drainage (MLD) of the neck on electroencephalography (EEG) in subjects with psychological stress. [Methods] Twenty-six subjects were randomly allocated to receive one 15-min session of either MLD or resting on a bed (control). [Results] Analysis of EEG in the MLD group showed a significant increase in relaxation, manifested as an increase in average absolute and relative delta and alpha activity. [Conclusion] It is suggested that MLD provides acute neural effects that increase relaxation in subjects with psychological stress.
Key words: Manual lymph drainage, Electroencephalogram, Psychological stress

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INTRODUCTION

The term manual lymph drainage (MLD) was coined by the Vodders during their years of developing many of the techniques in use today. The Vodder technique of MLD is the most widely practiced method in Asia, Europe, North America, and countries in other areas of the world[1, 2)]. MLD is widely employed for medical disorders, such as lymphedema, phlebedema, lipedema, postsurgical edema, arthropathy, and rheumatic disease; cosmetic disorders; gynecological disorders; neurological disorders; and autonomic retuning and as a health spa treatment[3, 4)].

MLD affects the treatment of edema and acts on the body in various ways[3, 4)], especially on the psychological and physical changes that result from stress, the environment, and other factors[3)]. This means that the appropriate application of MLD to subjects who are in a state of disharmony with regard to their psychological and physical status restores them to a normal state, with MLD having a tonic effect on the smooth muscle of lymph vessels that possess numerous sensory nerve endings with connections to the autonomic nervous system (ANS) and other human systems[4–6)].

There are many articles have investigated the effects of massage on stress, pain, systems, fatigue, anger, fear, the autonomic nervous system, and brain state[7–11)]. However, study of the effect of MLD on electroencephalography (EEG) has not been reported. Therefore, the aim of this study was to objectively investigate the EEG performance of subjects with psychological stress under MLD of the neck.

SUBJECTS AND METHODS

The subjects included 115 university students. They were chosen according to the following criteria: 1) no history of mental illness, 2) not currently taking any medication known to affect EEG signal, and 3) no known heart- or muscle-related disease. All responded to the stress responses inventory (SRI)[12)] and returned it to the authors. They were asked how they respond to stressful situations (e.g., emotionally, cognitively, somatically, or behaviorally) and to write 39 responses to stressful situations. According to the results of the questionnaire, 26 subjects with an SRI score >80 were enrolled in the study. They were randomly allocated to receive a 15-min session of either MLD or rest (control).

Participants were asked whether they suffered from any cardiovascular diseases or endocrine disorders. If so, they were excluded from the study. 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 interventions were completed in a supine position on a massage table with a pillow placed under the knees to relax the low back muscles. Data acquisition and MLD took place in a quiet temperature-controlled environment (22–24°C). Talking, phone calls, and noise that could increase the activity of the sympathetic nervous system were minimized[13)], and the subject's body was covered with a soft, thin sheet so as to avoid discomfort from body exposure.

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Subjects were allowed to rest comfortably for at least 5 min prior to the baseline recording procedure. EEG was performed for 5 min prior to performing MLD. Subjects in the experimental group received MLD of the neck for 15 min, while the subjects in the control group relaxed by lying quietly for the same time period. The technique was applied in the areas of the neck twice. The MLD procedure can be found in detail in Dr. Vodder's Manual Lymph Drainage: A Practical Guide[3]. The protocol was standardized in that the stroke category (type) and time of each stroke was the same between all participants.

A total 18 channels of EEG were recorded, including FP1, FPZ, FP2, F7, F3, FZ, F4, F8, T3, C3, CZ, C4, T4, T5, P3, PZ, P4, and T6. There were two other electrodes, which were placed on both zygomatic bones as a ground electrode and reference electrode. EEG was recorded before and immediately after the treatment. Participants were asked to close their eyes and refrain from talking, falling asleep, or making exaggerated body movements during EEG measurement. Analysis was based on a 5-min period of EEG signal acquisition, followed by computerized Fourier analysis of the EEG waves using the TeleScan software package (LAXTHA, Daejeon, South Korea). The signal was sampled at a rate of 256 Hz and was digitally filtered using a 1–50 Hz band-pass filter. Absolute and relative power values were obtained for delta (1–4 Hz), theta (4–8 Hz), alpha (8–13 Hz), and beta (13–30 Hz). The spectral power data (μV^2) were subjected to a $\log_{10}$ transformation. All outcome measures were determined and analyzed by an investigator who was blinded and was not obligated to provide any intervention for subjects.

Data are given as mean ± SD values. All variables were tested for normality using the one-sample Kolmogorov-Smirnov test and did have a normal distribution. The paired t-test was used to test for homogeneity and to compare the pre-MLD and post-MLD results for differences in EEG. The collected data were analyzed using a statistical package program (SPSS ver. 19.0). A two-tailed probability of $p<0.05$ was considered statistically significant.

RESULTS

The general characteristics did not differ statistically between the two groups at baseline ($p>0.05$, Table 1).

The average absolute and relative EEG subband power distribution did not differ statistically between the two groups at baseline ($p>0.05$, Tables 2 and 3). The post-MLD average absolute alpha rhythm was significantly higher in the experimental group ($p<0.05$, Table 2). There were also significant difference between the pre-MLD and post-MLD average relative alpha and delta rhythms in the experimental group ($p<0.05$, Table 3).

DISCUSSION

The main purpose of the present study was to investigate the effect on acute brain activity of MLD in subjects with psychological stress by using EEG. Although the effect of various massages on brain activity has been previously observed[15–17], we are not aware of any reports on the effects of MLD on brain activity using EEG power. So, to the best of our knowledge, this is the first study to investigate the differences in brain activity resulting from MLD. This study demonstrates that MLD of the neck area is effective for promoting relaxation, manifested as an increase in post-MLD average absolute alpha rhythm, relative delta rhythm and alpha rhythm ($p<0.05$). Comparison between the two groups in the present study revealed that subjects receiving MLD had significantly higher alpha and delta activities than those in the control group. This finding indicates psychological benefits of MLD over resting for stress reduction in subjects with stress.

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

Variable	Group	
	MLD (n=14)	Control (n=12)
Age (yrs)	21.2±1.2	20.9±1.4
Sex (Male/Female)	3/11	2/10
Height (cm)	163.7±4.5	165.3±5.4
Weight (kg)	58.3±8.5	60.1±6.0
Body Mass Index (kg/m^2)	21.8±3.0	21.9±1.8

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

Type		Pre	Post
δ (μV^2)	MLD	1.44±0.80	1.61±0.89
	Control	1.61±0.42	1.79±0.59
θ (μV^2)	MLD	3.52±0.56	3.56±0.52
	Control	3.53±0.58	3.61±0.54
α (μV^2)	MLD	2.52±0.47	2.72±0.43*
	Control	2.49±0.56	2.52±0.45
β (μV^2)	MLD	2.62±0.51	2.31±0.64
	Control	2.47±0.32	2.51±0.43

All variables are means ± SD.
MLD: Manual lymph drainage
*p<0.05

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

Type		Pre	Post
δ	MLD	0.17±0.059	0.19±0.059*
	Control	0.18±0.058	0.19±0.042
θ	MLD	0.51±0.08	0.54±0.07
	Control	0.53±0.11	0.52±0.11
α	MLD	0.18±0.04	0.22±0.05*
	Control	0.18±0.094	0.19±0.04
β	MLD	0.07±0.033	0.08±0.054
	Control	0.08±0.049	0.09±0.048

All variables are means ± SD.
MLD: Manual lymph drainage
*p<0.05

The mechanism by which MLD promotes relaxation and changes in brain activity may be explained by the findings of Kim et al[7]. They reported that MLD contributed to increased cardiac parasympathetic activity, which led to decreased sympathetic activity in the neuromuscular system; thus, it can cause relaxation. Alpha waves are dominant under relaxed conditions, whereas beta wave becomes dominant under excited conditions. Delta waves are found during some parts of sleep[18]. Our finding of reduced cortical arousal through MLD may also be explained by the findings of other studies[14, 15]. They reported the state induced by massage techniques represent a hypoactive central nervous system state that may by similar to stageIsleep. Since MLD is a kind of light pressure massage, it is possible that the same mechanism was partly responsible for the decrease in psychological stress observed in this study.

The clinical implication of the present study is that MLD was found to be an effective intervention for stress reduction in subjects with psychological stress. Moreover, interpretation of brain activity of subjects in this study demonstrated greater relaxation after MLD compared with control group. The beneficial effects found could be used as a guide for good treatment for stress reduction in subjects with stress.

Regarding limitations of this study, we did not use other secondary outcome measures in order to subjectively quantify subject anxiety and pain intensity and only evaluated the acute effects of MLD. Further studies should include other outcome measures and specific treatment groups, and longitudinal study of MLD effects on brain activity using EEG would be an interesting direction.

In conclusion, the present study is the first report of the effect of MLD on acute brain responses using EEG. The study provides insight into physiological changes of relaxation associated with MLD. The findings reveal that a single 15-min session of MLD at the neck region produces an immediate decrease in brain activity. It is recommended that MLD be considered as an alternative treatment for stress in subjects with psychological stress.

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