

Effects of Cosmetic Therapy on Cognitive Function in Elderly Women: a Near Infrared Spectroscopy Study

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It is important to establish methods for maintaining or improving cognitive function in elderly people. Here, we employed time-resolved spectroscopy (TRS) to evaluate the effect of cosmetic therapy on prefrontal cortex (PFC) activity in elderly females. Based on the Mini-Mental State Examination (MMSE) score, the subjects were classified into mild and moderate cognitive impairment groups. Cosmetic therapy significantly increased the baseline concentrations of oxy-Hb and t-Hb in the left PFC in the mild cognitive impairment group. However, cosmetic therapy did not change oxy-Hb and t-Hb in the moderate cognitive impairment group. These results suggest that cosmetic therapy affects cognitive function by altering PFC activity in elderly women with mild cognitive impairment, but not moderate cognitive impairment.

1. Introduction

Neuropsychological disorders such as dementia and depression in the elderly are important issues in aging societies, and various non-pharmacologic therapies have been examined for maintaining a healthy physical and mental status. Females exhibit a higher rate of population aging and a higher incidence of dementia than males. Therefore, it is important to establish non-pharmacologic therapies suitable for aged females. For example, cosmetic therapy has recently received attention as an effective new method for improving cognitive function and QOL in aged females [1]. However, the neurophysiological mechanism of cosmetic therapy is not yet clear. In the present study, we employed near infrared spectroscopy to evaluate the effect of cosmetic therapy on cerebral blood oxygenation (CBO) in the prefrontal cortex (PFC) in aged females with various levels of cognitive impairment.

2. Subjects and Methods

2.1 Chronic effects of cosmetic therapy

The subjects of this study were 61 elderly women (age: 82.2 ± 6.3 years). They had mild to moderate levels of dementia and were living in a nursing home. We evaluated cognitive impairment of the subjects employing the Mini-Mental State Examination (MMSE), which is the most commonly used examination for screening cognitive function, before cosmetic therapy. All subjects provided written informed consent as required by the Ethics Committee of Shiseido.

In order to assess the chronic effects of the cosmetic therapy, we evaluated MMSE scores before and after the three-month cosmetic therapy program and calculated the change of MMSE score in each subject. We compared the changes of MMSE scores in the cosmetic therapy group ($n=7$, 92.3 ± 6.2 years) and the control group ($n=8$, 86.7 ± 6.6 years). There was a significant difference in ages between the two groups.

2.2 Acute effects of cosmetic therapy

We evaluated acute effects of cosmetic therapy (50 min) on aged women. According to the MMSE scores, the subjects were classified into the mild cognitive impairment group ($n = 32$; mean score 24.1 ± 3.8) and the moderate cognitive impairment group ($n = 29$; mean MMSE score 10.3 ± 5.8 , $p < 0.0001$). There was no significant difference in age between the mild (83.3 ± 6.3 years) and moderate (81.6 ± 6.0 years) cognitive impairment groups ($p > 0.05$).

We evaluated CBO in the PFC in a resting condition, employing a time-resolved near infrared spectroscopy (TRS). Then, we evaluated the effect of cosmetic therapy on the CBO. We used a TRS-20 system (Hamamatsu Photonics K.K, Hamamatsu, Japan), which has been used in several functional studies on normal adults [2, 3]. Details of this system have been described previously [2, 3]. Briefly, it consists of three pulsed laser diodes with different wavelengths (761 nm, 791 nm, and 836 nm) having a duration of 100 ps at a repetition frequency of 5 MHz, a photomultiplier tube, and a circuit for time-resolved measurement based on the time-correlated single photon counting method. The observed temporal profiles were fitted into the photon diffusion equation using the non-linear least-squares fitting method. The reduced scattering and absorption coefficients for the three wavelengths were calculated. The concentrations of oxy-Hb, deoxy-Hb, and total Hb ($=\text{oxy-Hb} + \text{deoxy-Hb}$; t-Hb) were then calculated using the least-squares method. The concentrations of Hb were expressed in μM . The distance between the emitter and detector was set at 3 cm.

3. Results

Fig. 2 compares MMSE scores of the cosmetic therapy and control groups. Interestingly, the control group exhibited a decrease of MMSE scores after three months. In contrast, the cosmetic therapy group did not, and there was a significant difference between the MMSE scores of the two groups after 3 months ($p < 0.05$).

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Fig. 1 Changes of MMSE scores after cosmetic therapy

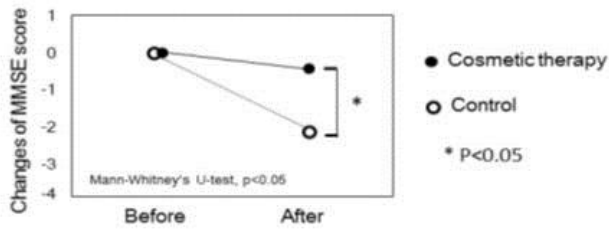
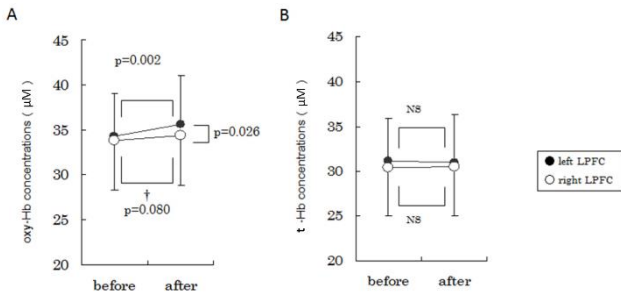


Fig. 2 shows acute effects of cosmetic therapy (50 min). The cosmetic therapy significantly increased the baseline concentrations of oxy-Hb ($p < 0.002$) and t-Hb ($p < 0.0013$) in the left PFC in the mild cognitive impairment group. In contrast, the right PFC exhibited slight increases of oxy-Hb and t-Hb, but these were not statistically significant. In the moderate cognitive impairment group, the cosmetic therapy did not change the concentrations of oxy-Hb and t-Hb in the PFC ($p > 0.05$).

Fig. 2 Effect of cosmetic therapy on baseline concentrations of oxy-Hb in the mild (A) and moderate (B) impairment groups



4. Discussion

The results of MMSE indicate that the aged women in the control group tended to show a decrease of cognitive function during 3 months; however, cosmetic therapy inhibited this decline. TRS demonstrated that cosmetic therapy increased the baseline concentrations of oxy-Hb and t-Hb in the PFC, suggesting that the therapy increased neuronal activity of the PFC at rest, since oxy-Hb and t-Hb reflect regional cerebral blood flow and blood volume, respectively [4]. Considering that the PFC plays important roles in various higher brain functions, the effect of cosmetic therapy on aged women might be achieved through activation of the PFC.

Interestingly, the cosmetic therapy increased the baseline concentrations of oxy-Hb and t-Hb mainly in the left PFC, resulting in left-dominant PFC activity. It has been reported that the right PFC is dominant for negative emotions and the left PFC is dominant for positive emotions [5, 6]. These findings suggest that the cosmetic therapy induced positive emotions. Indeed, most of the subjects smiled after cosmetic therapy. It should be noted, however, that such increases of PFC activity induced by cosmetic therapy were observed only in the mild cognitive impairment group. These findings suggest a limitation in the effectiveness of cosmetic therapy on aged women.

References

- [1] Japan Society for Dementia Research, Textbook for dementia, Tokyo, Chugai-Igakusha, (2009)
- [2] Sakatani K, Tanida M, Hirao N, Takemura N Ginkobiloba extract improves working memory performance in middle-aged women: role of asymmetry of prefrontal cortex activity during a working memory task. *Adv Exp Med Biol*.812:295-301, (2014)
- [3] Tanida M, Sakatani K, Tsujii T Relation between working memory performance and evoked cerebral blood oxygenation changes in the prefrontal cortex evaluated by quantitative time-resolved near-infrared spectroscopy. *Neurol Res* 34:114-119 (2012)
- [4] Hoshi Y, Kobayashi N, Tamura M Interpretation of near-infrared spectroscopy signals: a study with a newly developed perfused rat brain model. *J Appl Physiol* 90: 1657-1662 (2001)
- [5] Hellige JB Hemispheric Asymmetry. Harvard University Press, Cambridge, MA, USA (1993)
- [6] Ishikawa W, Sato M, Fukuda Y, Matsumoto T, Takemura N, Sakatani K. Correlation between asymmetry of spontaneous oscillation of hemodynamic changes in the prefrontal cortex and anxiety levels: a near-infrared spectroscopy study. *J Biomed Opt.* 9:027005 (2014)