Chapter 36
Effects of Cosmetic Therapy on Cognitive Function in Elderly Women Evaluated by Time-Resolved Spectroscopy Study

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Abstract With the rapid increase in dementia in developed countries, it is important to establish methods for maintaining or improving cognitive function in elderly people. To resolve such problems, we have been developing a cosmetic therapy (CT) program for elderly women. However, the mechanism and limitations of CT are not yet clear. In order to clarify these issues, we employed time-resolved spectroscopy (TRS) to evaluate the effect of CT on prefrontal cortex (PFC) activity in elderly females with various levels of cognitive impairment. Based on the Mini-Mental State Examination (MMSE) score, the subjects were classified into mild (mean MMSE score: 24.1 ± 3.8) and moderate (mean MMSE score: 10.3 ± 5.8) cognitive impairment (CI) groups ($p < 0.0001$). The mild CI group exhibited significantly larger baseline concentrations of oxy-Hb and t-Hb than the moderate CI group. CT significantly increased the baseline concentrations of oxy-Hb ($p < 0.002$) and t-Hb ($p < 0.0013$) in the left PFC in the mild CI group. In contrast, CT did not change the concentrations of oxy-Hb and t-Hb in the moderate CI group ($p > 0.05$). These results suggest that CT affects cognitive function by altering PFC activity in elderly women with mild CI, but not moderate CI.

Keywords Aging • NIRS • Prefrontal cortex • Stress • Cortisol

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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, 2]. However, the neurophysiological mechanism of cosmetic therapy is not yet clear. In the present study, we employed time-resolved spectroscopy (TRS) 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 Methods

2.1 Subjects

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.

2.2 Cosmetic Therapy

We have developed a cosmetic therapy program which begins with deep breathing using fragrances and relaxing light exercise, followed by skin care and make-up. A seminar-style session was presented in which subjects followed the guidance of instructors (beauty therapists). Based on directions given by beauty therapists, skin care products were applied to their skin, and make-up was applied to their faces. Beauty therapists encouraged subjects to perform by themselves as much as possible. Before the end of the therapy, instructors and subjects were encouraged to comment to one another about the changes in their impression and appearance. The therapy lasted approximately 50 min, and the daily treatment was continued for 3 months.

2.3 Study on Cognitive Function

First, in order to assess the effects of the cosmetic therapy on cognitive function in aged women, we evaluated MMSE scores before and after the 3-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.

2.4 Functional Study by TRS

In this study, we evaluated cognition in 61 aged women (82.5 ± 6.2 years). 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 ($p > 0.05$).

First, we evaluated CBO in the PFC in a resting condition, employing TRS. Then, we evaluated the effect of cosmetic therapy on the CBO. It should be noted that, unlike continuous wave NIRS, TRS employs pico-second light pulses and the photon diffusion equation, and enables us to measure the absolute total hemoglobin (Hb) concentration at the resting condition [3]. Therefore, the TRS probe can be removed during cosmetic therapy. We used a TRS-20 system (Hamamatsu Photonics K.K, Hamamatsu, Japan), which has been used in several functional studies on normal adults [4, 5]. Details of this system have been described previously [4, 5]. Briefly, it consists of three pulsed laser diodes with different wavelengths (761, 791, 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 (=oxy-Hb + 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

Figure 36.1 compares MMSE scores of the cosmetic therapy and control groups. Interestingly, the control group exhibited a decrease of MMSE scores after 3 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 ($p < 0.05$).

Employing TRS, we evaluated CBO in the PFC in the resting condition before and after cosmetic therapy. The mild cognitive impairment group exhibited significantly larger baseline concentrations of oxy-Hb and t-Hb than the moderate cognitive impairment group (Fig. 36.2). There were no significant differences in baseline concentrations of oxy-Hb and t-Hb between the right and left PFC.

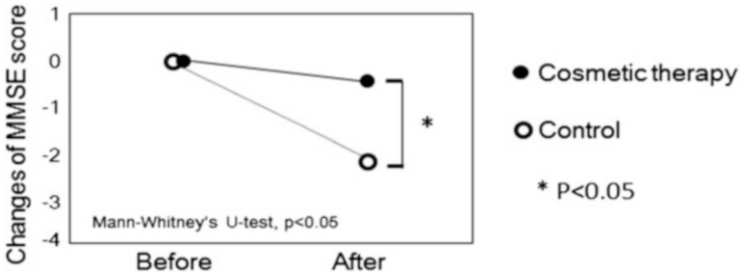

Fig. 36.1 Changes of MMSE scores after cosmetic therapy

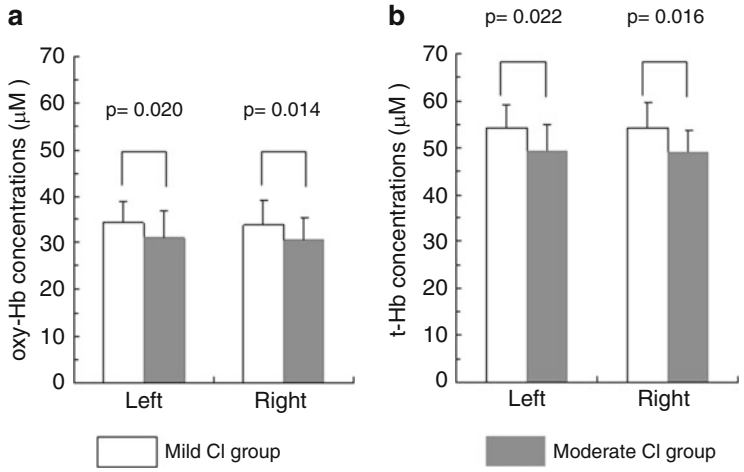

Fig. 36.2 Differences in baseline concentrations of oxy-Hb (**a**) and t-Hb (**b**) in the bilateral PFC between the mild and moderate cognitive impairment groups

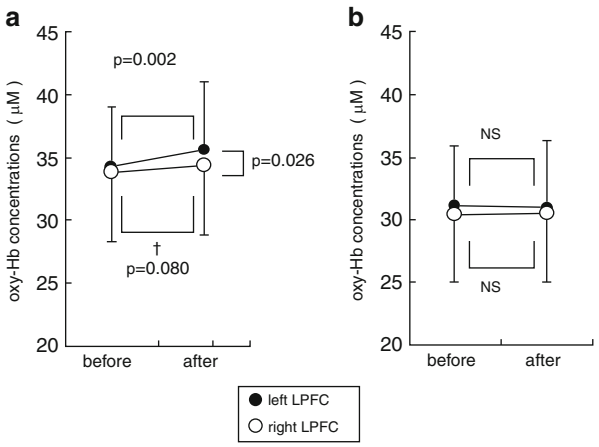

Fig. 36.3 Effect of cosmetic therapy on baseline concentrations of oxy-Hb (**a**) and t-Hb (**b**) in the PFC in the mild cognitive impairment group

Daily cosmetic therapy (50 min) 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 (Fig. 36.3). 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 ($p > 0.05$).

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 [6, 7]. 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 [8, 9]. 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.

The following limitations should be mentioned. Firstly, there was a significant difference in ages between the cosmetic and control groups in the study on cognitive function. In this study, we did not randomize the subjects, but classified the subjects into the two groups according to the floor on which they resided in the nursing home in order to avoid the possibility that interpersonal relationships might be adversely affected if subjects in different groups were mixed on one floor. It should be emphasized that, although the average age of the cosmetic group was older than that of the control group, the cosmetic group showed a higher MMSE score than the control group after the therapy. In addition, in the functional study by TRS, there was no significant difference in age between the mild and moderate cognitive impairment groups. Secondly, the physiological mechanism of the effect of cosmetic therapy is not clear. The cosmetic therapy had several components, including sensory stimulation with fragrances and skin care. It has been reported that sensory stimulation by aromatherapy and acupuncture improved cognitive function in dementia [10, 11]. We think that the effect of cosmetic therapy on cognitive function is holistic rather than being due to a single factor. Finally, we evaluated only the acute effects of cosmetic therapy on PFC activity in the functional study by TRS. Further studies are necessary to evaluate chronic effects of cosmetic therapy on PFC activity.

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