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Research paper

A study of the effect of lavender floral-water eye-mask aromatherapy on the autonomous nervous system

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ABSTRACT

Introduction: In contrast to traditional essential aromatherapy, few studies have focused on floral-water eye-mask aromatherapy. This paper presents the effects of using eye-mask aromatherapy treatment with lavender floral water on the autonomous nervous system by using the neural network (NN) based data analysis method.

Methods: Twenty two students with long term stress were given eye-mask aromatherapy treatment. Two eyes with the makeup cotton sheets moistened lavender floral water. Heart rate variability (HRV) was measured to estimate the status of the autonomic nervous system before and after the treatment. The NN data relationship analysis method was used to explore the relationship between the eye-mask aromatherapy and the psychological factors associated with HRV.

Results: From the NN based data analysis, relationship weightings of psychological factors of the autonomic nervous system changed from 1.6 to 9.1 times after the eye-mask aromatherapy. Moreover, the physical stress index was reduced by 33.5% and total power of HRV was increased by 44.5%, which demonstrated that stress relief occurred as a result of the lavender floral-water eye-mask aromatherapy. The balance of the autonomic nervous system was also improved because the LF/HF ratio was closer near the normal value of healthy people.

Conclusions: The floral-water eye-mask aromatherapy provides an opportunity for use in integrative care by regulating the autonomic nervous system and reducing stress. Details on the principle actions of eye-mask aromatherapy on the autonomic nervous system is indicated from the NN data analysis, which is significant for the application of this potential aromatherapy intervention.

1. Introduction

Essential aromatherapy is a popular complementary therapy, where aromatic essential oils extracted from plants are utilized through massage or inhalation treatment. Aromatic molecules can pass through the nasal cavity and the skin to the central nervous system and human brain, so that a desired response of human body is stimulated. Aromatherapy has been shown both medically and psychologically as having a positive significant effect [1–5]. Research has indicated that aromatherapy is able to reduce blood pressure and heart rate as well as increase the activity of the parasympathetic nervous system [6–8]. In turn, performing aromatherapy achieves the effect of emotional relief and stress relaxation, even leading to in-depth relaxation and pain transfer. For example, the health benefits of lavender essential oil include anti-microbial, sedation, and anti-depression [9]. On the other hand, since stress is the body's reaction to events, thoughts, or emotions, the use of heart rate variability (HRV) [10] can be used to demonstrate the psychological changes associated with stress using even simple deep breathing exercises. Research indicates that HRV reflects the status of autonomic nervous system, cf. [11]. And if HRV is measured, this can provide more objective scientific evidence on the effect of an intervention such as aromatherapy. In other words, the HRV changes before and after performing aromatherapy can demonstrate the effective level of stress adjustment and emotional relief. However, most aromatherapy studies have evaluated the effect using basic psychological measurements and focusing on the aroma inhalation approach [12,13]. The eye-mask aromatherapy (i.e., immersion-based aromatherapy) has previously been omitted because of its indirect approach of passing the aromatic molecules to the central nervous system through the skin. Thus, the eye-mask aromatherapy is still an emerging field of research.

Floral water (hydrosol) is the condensate by-product of steam or water distillation during the essential oil extraction process [14,15]. As well as containing 0.5% of an essential oil, the composition of floral water also contains water-soluble substances

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and some trace elements which do not exist in general essential oils. As well as some of the similar characteristics found in essential oils, it has characteristics which essential oils do not have [16]. For example, the lavender floral water has a prevention effect for body skin and an emotion curative effect [17,18]. In contrast to essential oil, the floral water can be directly used on the skin without needing dilution procedure. The water-soluble substances and trace elements of the floral water can be absorbed through inhalation, water immersion, with the properties of aromatherapy. However, the applications of the floral water have not been investigated because most of people deem the effects of the floral water to be similar as essential oil. Moreover, the interaction of autonomic nervous system from the floral water is unknown [12].

From the pioneering work of Rumelhart, Hinton, and Williams [19], artificial neural network (ANN) has widely been applied on engineering systems, such as control systems [20–22], communication [23], data classification [24], etc. Based on the back-propagation neural network (BPNN) method, the ANN is trained to approximate system behaviors, such that the ANN provides an alternative method to solve complicated and nonlinear problems (e.g., [21,25]). It has the advantages of fault tolerance and no needed mathematical model, and it is therefore robust for artificial analysis of engineering problems. Furthermore, the learning convergence of the neural network has been proven with high accuracy, cf. [26]. Since the neural network uses the least-square and steepest-descent method which is a kind of optimal regression approach, the neural network can emulate the data system in an optimized manner even if less data samples are considered. In contrast, traditional regression analysis or statistics commonly require a very large amount of data to obtain an acceptable analyzed result. As a result, the uncertainty and incompleteness of the experiment can be reduced by the neural network theory, so that the constructed data model is correct. Thus, the neural network theory can be an assistant method for data analysis. Unfortunately, although the data learning can be achieved by the ANN, the applications of data relationship analysis are lacked in literature. This is because the ANN can model only the input/output function but lack capability of relationship classification. In other words, the ANN cannot be directly applied on data relationship analysis, i.e., a new data modeling method of ANN is required for this study.

From the above, this paper will study the effect of the eye-mask aromatherapy treatment with the lavender floral water and apply the neural network (NN) on assistant analyzing of the influence activity. First, a standard floral-water eye-mask aromatherapy treatment is proposed for the experiment. When the eyes are covered by the cotton mask immersed in the lavender hydrosol, the floral water is absorbed by the eye skin and olfactory organs. The aromatic molecules diffuse into the blood and are transported to various organs through the blood circulation, such that the central nervous system receives them and acts some significant effects. To identify the effect of the eye-mask aromatherapy, the physiological indexes of the autonomic nerve system are measured including the heart rate variability and its power spectral parameters – high frequency (HF), total power (TP), etc. These physiological indexes will be used to evaluate the autonomic nerve activity before and after performing eye-mask aromatherapy treatment. On the other hand, the BPNN is modified with involving new relationship weightings in the input of the neural network for the data relationship analysis. Based on the back-propagation learning method, the NN model establishes the relationship for floral water's effect of the human body from assessing the physiological influence impact weighting. We can evaluate which physiological factor influences pressure index and the state of autonomous nervous system. The results indicate that lavender floral-water eye-mask aromatherapy is able to relax the physical stress. Moreover, the lavender floral-water eye-mask aromatherapy results in anti-depression and sedation. Therefore, the proposed NN relationship modeling method can help the data analysis to obtain more correct and detailed results in comparison with only using a statistical analysis method.

In Section 2, the experimental method of the floral-water eye-mask aromatherapy is described, and the data analysis method of neural network is introduced. In Section 3, the effects of the eye-mask aromatherapy are discussed. Finally, some conclusions are made in Section 4.

2. Methods

2.1. Method of eye-mask aromatherapy

In the experiments, the eye-mask aromatherapy treatment was performed via lavender floral water. The lavender water was mixed by lavender floral water organically produced by Alteya Group LLC, Bulgaria, and pure water in 1 proportion to 3. The floral-water eye mask was made by soaking makeup cotton sheets in the lavender water. When carrying out the eye-mask aromatherapy, two eyes of each subject were covered with the floral-water cotton sheet as illustrated as Fig. 1. The floral water permeated the eyes and diffused smell to the respiratory system, so that the autonomic nervous system was changed after the eye-mask aromatherapy. To observe and analyze the physiological effect of the eye-mask aromatherapy, the following standardized procedure was employed.

Subjects rested lying down for 5 to10 min before the experiment began. This was followed by their first measurement of heart rate variability. Eye-mask aromatherapy was then performed by moistening the makeup cotton sheets with the lavender floral water. The sheets were placed over both eyes for 15 min as illustrated as Fig. 1. After a ten-minute rest, the heart rate variability was measured for a second time. This allowed the comparison of HRV before and after the eye-mask aromatherapy.

To reduce uncertain influences on the experiment, the following rules were observed: (1) a quiet room was chosen as the test site to reduce disturbance to subjects, where the room temperature was maintained at 26 °C; (2) the test was performed at a specific time from 19:00 to 21:00 in everyday to avoid differences in heart rate variability due to time of day ; (3) all subjects refrained from medications and stimulation beverages (such as coffee, tea, and alcohol) as well as being too full or hungry prior to the experiment; 4) any metal or nail polish objects were removed from the body for getting correct data when measuring the factors of the heart rate variability.

Fig. 1. Treatment of eye-mask aromatherapy. (The use of this photo has been authorized by the subject).