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Evaluation of the peripheral blood hemoglobin concentration and brain activity

-Using optical topography (feature values)-

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Abstract

Optical topography has attracted attention as an examination method for visualizing brain activity. In this method, the head is irradiated with near-infrared light, and the hemoglobin absorption in the brain tissue is measured, which allows the mapping and visualization of brain activity. We gave tasks to patients, and evaluated changes in near-infrared ray absorption, i.e., changes in the oxyhemoglobin concentration in the local brain tissue using optical topography, and determined whether the oxyhemoglobin concentration as a parameter of brain activity is affected by the peripheral blood hemoglobin concentration. As a result, there was no significant correlation between the peripheral blood hemoglobin concentration and changes in the oxyhemoglobin concentration due to the tasks. These results suggest that the numerical expression of brain activity is possible using optic topography without being affected by the peripheral blood hemoglobin concentration. Tottori J. Clin. Res. 7(1), 21-25, 2016

Key words: optical topography, near-infrared light, oxyhemoglobin, auxiliary diagnosis of depressive symptoms, verbal fluency task

1. Introduction

In recent years, the number of patients with psychiatric disorders has markedly increased, being 3,200,000 in 2011. In addition to cancer, stroke, myocardial infarction, and diabetes mellitus, psychiatric disorders are designated as one of the 5 major diseases specified by the Ministry of Health, Labour and Welfare based on the Medical Care Act. Mood disorders such as depression are diagnosed mainly by a medical interview. Therefore, objective diagnosis is difficult, and diagnosis is time-consuming. However, previous studies have shown differences in the pattern of changes in the brain blood flow among psychiatric disorders. Optical topography, which allows the visualization of brain activity, is used as an auxiliary method for the differential diagnosis of depressive symptoms.

Optical topography is an examination method in which the head is irradiated with near-infrared light, and light that penetrates 2-3 cm deep from the scalp and is scattered and detected. Near-infrared light readily passes through the body such as the bone and muscle, and its absorption differs according to the amount of oxygen bound to hemoglobin in the local tissues. In optical topography, from near-infrared ray absorption, the ratio of oxyhemoglobin (oxy-Hb) to deoxy-hemoglobin (deoxy-Hb) in the local brain tissue and the total hemoglobin (total-Hb) as the sum of oxy- and deoxy-Hb are calculated, and their values in each brain area are mapped as a parameter of brain activity. This method, which allows the visualization and numerical expression of brain activity, has attracted attention in recent years[1)].

2. Subjects and Methods

The subjects consisted of 24 staff members (15 males and 9 females; mean age, 40.9 ± 22.7 years) who underwent a health checkup examination for staff members in 2012, and volunteered to undergo optical topography and 68 outpatients (31 males and 37 females; mean age, 42.9 ± 34.8 years) who visited the Department of Psychiatry in Hospital A from April, 2012, and were examined by optical topography (total, 92 subjects; 46 males and 46 females; mean age, 42.4 ± 32.0 years). Under