Prediction of MMSE score using time-resolved near-infrared spectroscopy

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Abstract: Time-resolved near-infrared spectroscopy (TNIRS) enables us to assess baseline concentrations of hemoglobin (Hb) in the prefrontal cortex (PFC) which reflect regional cerebral blood flow and neuronal activity at rest. We have demonstrated that baseline concentrations of oxy-, deoxy-, total-Hb (μM/L), and oxygen saturation (SO^2) (%) measured by TNIRS correlated with mini mental state examination (MMSE) scores in ISOTT2016 [1]. In the present study, we investigated whether TNIRS measured-Hb concentrations at rest allow us to predict MMSE scores in aged people with various cognitive function. We studied 202 subjects (male 87, female 115, age 73.4±13); we measured cognitive function by MMSE, and measured baseline concentrations of oxy-, deoxy-, total-Hb, and SO2 in the bilateral prefrontal cortex by TNIRS. We employed Machine learning techniques, i.e., deep neural network, support vector machine, random forest and self-organizing map for assessment of prediction of MMSE scores based on the Hb concentrations. From the analysis results by leave-one-out cross validation, a deep neural using the tanh activation function with dropout algorithm showed 97% accuracy for prediction of the MMSE score, i.e., 2 classes of $x < 24$ and $24 \leq x$. Not only the baseline concentration of SO^2, but also of oxy-, deoxy-, total-Hb contributed to the prediction accuracy. These results suggest TNIRS may be a useful tool for screening test of cognitive impairment; particularly, mild cognitive impairment (MCI).

References

[1] Y Murayama, et al. Relation between cognitive function and baseline concentrations of hemoglobin in prefrontal cortex of elderly people measured by time-resolved near-infrared spectroscopy. Adv Exp Med Biol (in press)

Acknowledgements: This work was supported in part by JSPS Grant-in-Aid for Young Scientists (B) Grant Number 16K16077, Strategic Research Foundation Grant-aided Project for Private Universities (S1411017) from the Ministry of Education, culture, Sports, Sciences and Technology of Japan, and grants from Ling Co., Ltd. (Tokyo, Japan) and Southern Tohoku General Hospital (Fukushima, Japan).

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