عنوان مقاله:

The Temporal Confounding Effects of Extra-cerebral Contamination Factors on the Hemodynamic Signal Measured by Functional Near-Infrared Spectroscopy

محل انتشار:

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Abstract Introduction: Functional near-infrared spectroscopy (fNIRS) has been broadly applied for optical brain imaging. This method is hemodynamic-based functional brain imaging relying on the measurement of the neurovascular coupling to detect changes in cerebral neuronal activities. The extra-cerebral hemodynamic changes are important contaminating factors in fNIRS measurements. This error signal can be misinterpreted as cerebral activities during fNIRS studies. Recently, it was assumed that temporal changes in deoxygenated hemoglobin concentration [HHb] was hardly affected by superficial blood flow, and it was proposed that the activation maps could be determined from [HHb] at large source-detector separation.Methods: In the current study, we measured the temporal changes in [HHb] using a continues-wave fNIRS device at large source-detector separation, while superficial blood flow was stimulated by infrared lasers. A mesh-based Monte Carlo code was applied to estimate fNIRS sensitivity to superficial hemodynamic changes in a realistic ۳D MRI-based brain phantom.Results: First, we simulated photon migration in a four-layered human-head slab model to calculate PPLs and fNIRS sensitivity. Then, the localization of the infrared laser inside a realistic brain model was studied using the Monte Carlo method. Finally, the changes in [HHb] over the prefrontal cortex of six adult males were measured by fNIRS at a source-detector separation of ۳ cm. The results demonstrated that the relation between fNIRS sensitivity and an increase in S-D separation was nonlinear and a correlation between shallow and deep signals was observed.Conclusion: The presented results demonstrated that the temporal changes in the superficial blood flow could strongly affect HHb measurement at large source-detector separation. Hence, the cerebral activity map extracted from the [HHb] signal was mainly contaminated by superficial blood flow.

Keywords: Functional near-infrared spectroscopy Photobiomodulation Neurovascular coupling Superficial blood flow

کلمات کلیدی:

لینک ثابت مقاله در پایگاه سیویلیکا: