Functional near-infrared spectroscopy on acute sport-related concussion: can a brain activation pattern be used as a biomarker of concussion?

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Abstract

Statement of the Problem: Currently, the diagnosis and follow-up of acute sport-related concussion (SRC) is based mainly on symptom score (1). This may lead to underreported or underestimated episodes of concussion among contact-sport players or pre-emptive return to play (2, 3). Studies using task-related functional Magnetic Resonance Imaging (fMRI) reported abnormal brain activation patterns during neurocognitive tasks in SRC. This can be used as an objective parameter to assess players with suspected concussion and to track their recovery. However, the results are not consistent between fMRI studies (4). Functional Near-Infrared Spectroscopy (fNIRS) can be a valid alternative to assess the cerebral activation in concussed patients illuminating their brain with NIR light (4, 5). No study has been conducted on SRC within 72 hours of injury using fNIRS. The objective of this study is to identify a pathological brain activation pattern that can be used as a biomarker for concussion using fNIRS. Methodology & Theoretical Orientation: An observational study on concussed athletes within 72 hours from injury and non-concussed athletes is conducted using fNIRS. Results are compared with clinical assessment, validated neurocognitive tests (e.g. WAIS-IV) and neuroimaging techniques (e.g. Magnetic Resonance Spectroscopy). Finding: Preliminary results show the capacity to detect brain activations using fNIRS. Further measurements are needed to detect a constant activation pattern in SRC and establish its relation with neurocognitive tasks and imaging techniques. Conclusion & Significance: fNIRS is a valid tool to detect brain activation. Further measurements are needed to define the type of fNIRS signal that can be used as a biomarker of SRC.

Image

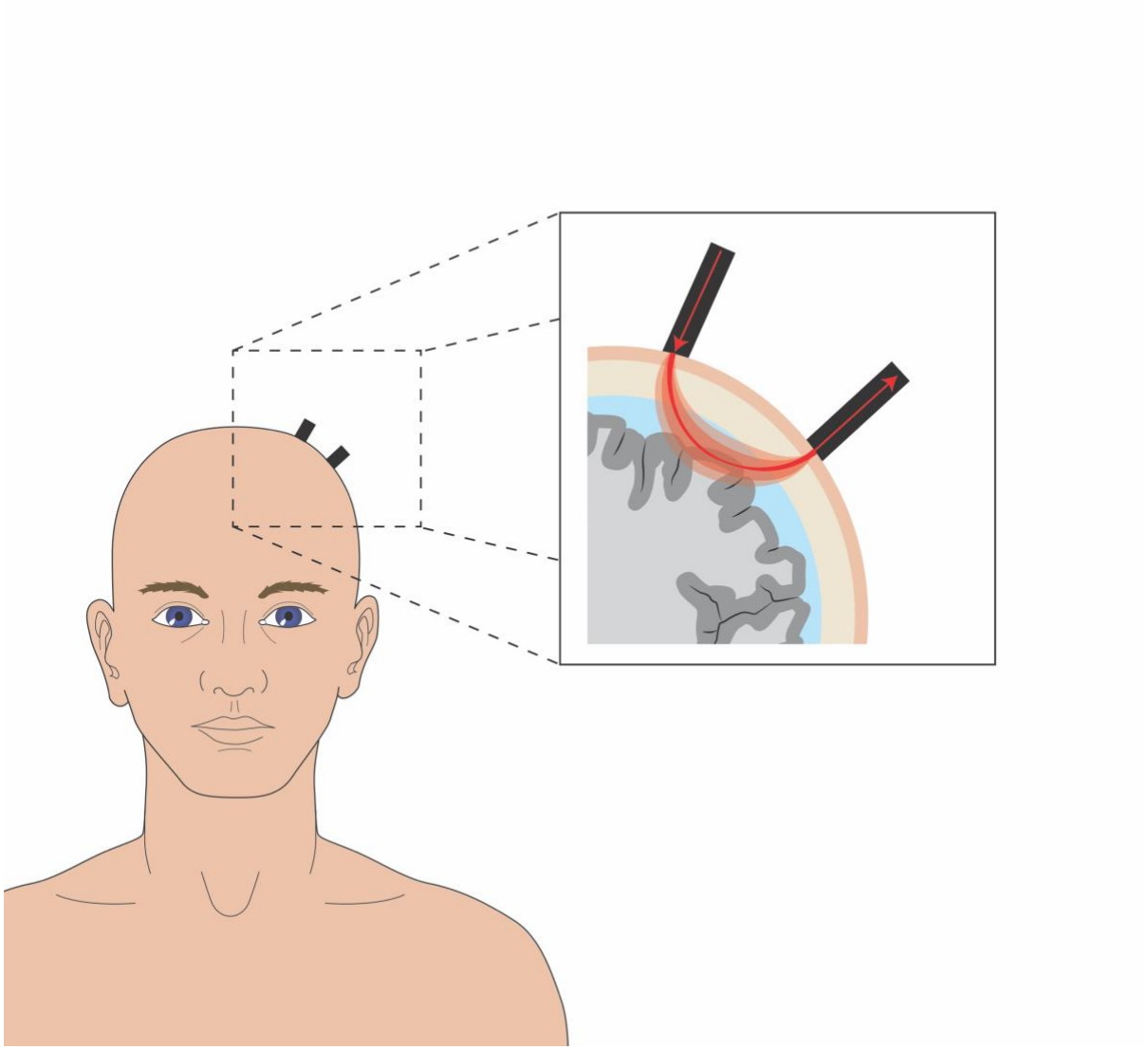


Figure 1: On the left, an emitter and a detector of near-infrared light (NIR) are represented placed on the scalp. On the right: A coronal section of the cranium shows the NIR light emitted passing through the extra-cranial tissue, the bone, the cerebral-spinal fluid and the surface of the brain. Picture taken from Forcione et al. "Cerebral Hemodynamic Influences in Task-Related Functional Magnetic Resonance Imaging and Near-Infrared Spectroscopy in Acute Sport-Related Concussion: A Review." 2018.

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Biography

Dr. Mario Forcione graduated in medicine in La Sapienza, University of Rome in 2015 with summa cum laude. Currently, he is a PhD student of the University of Birmingham and is working in the project “Brain Injury and Trauma Monitoring Using Advanced Photonics” financed by the European Union Horizon 2020 Research and Innovation Program under grant agreement 675332.

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