Challenges and solutions for using diffuse optics in brain injury

A recent article analyzes the complexity of using diffuse optics to monitor the brain when the head structure is altered, as in the case of an injury or a stroke. The study highlights how careless measurements may lead to wrong interpretation of the data, due to limitations of current techniques and a lack of knowledge about the underlying tissue. The article proposes new guidelines to improve measurement accuracy and reliability.

November 06, 2024

Hybrid diffuse optics is a technique that uses near-infrared light to measure tissue oxygenation and blood flow, which can be used to convey information about cerebral wellbeing. However, alterations in the brain structure and tissue composition can significantly affect optical signals in ways that do not reflect the brain assessments or that provide information about other tissues' clarity instead.

In a new article published recently in Neurophotonics, ICFO researchers Susanna Tagliabue, Michal Kacprzak, Federica Maruccia and Jonas Fischer, led by **ICREA Prof. Turgut Durduran,**

in collaboration with researchers from the Vall d'Hebron Hospital and Research Institute (VHIR), the team argues that heterogeneity in tissue composition, for example injuries or cerebrospinal fluid accumulations, can distort diffuse optical signals from their usual appearance on the healthy head or modify them according to its optical properties, making interpretation of results difficult. They identify the challenges of diffuse optics techniques in this difficult scenario, highlight features that can help other researchers in wiser data interpretation, and propose guidelines to improve the accuracy and reliability of measurements.

Investigating the signal alterations

To investigate the effects that tissue alterations have on diffuse optical signals, the authors performed measurements and computed tomography scans in three groups of patients with different pathologies, cerebral infarction, traumatic brain injuries, and brain hemorrhages, using them as case examples.

Researchers placed the probes on the patients' heads above different areas of interest that were selected using CT scans. The hybrid diffuse optical device employed in the study was built by the same researchers and comprises time-resolved spectroscopy, which measures hemoglobin concentration and tissue oxygen saturation, and diffuse correlation spectroscopy, which provides information on cerebral blood flow.

The article highlights the challenges of current optical methods in neuro-intensive care by detailing eight clinical case examples and analysing the diffuse optics signals quantitatively and qualitatively. **Researchers conclude that even though the heterogeneity of the brai tissue complicates the interpretation of results, hybrid diffuse optical methods have gre t potential in such scenarios if correctly used**They propose guidelines to help improve the accuracy and reliability of measurements, including the need for stricter quality control protocols, more sophisticated devices and more advanced analysis methods, intending to promote **a responsible and effective use of diffuse optics in neurocritical care, recognizing its limitations and optimizing the techniques** to obtain reliable information about brain physiology.