The multifaceted pathophysiology of traumatic brain injury (TBI) varies across the hyper-acute, acute, sub-acute and chronic phases (1-3): differences obviously exist depending on the mechanisms and severity of the TBI, as well as the type of post-traumatic injuries (open versus closed TBI, concussive versus non-concussive, characterised by the presence of focal or diffuse intracranial injuries). TBI induces endothelial cell impairment of the blood-brain barrier (BBB), but also mitochondrial dysfunction, disruption of cerebral autoregulation, cerebral blood flow velocity and cerebral vasoconstriction (4-8). Over the years, multimodality monitoring has been proposed to assess the pervasive changes unfolding after TBI (9,10); the study from Forcione et al. (11) expands on this area of research by exploring the application of commercially available optical devices to perform contrast-enhanced near-infrared spectroscopy (NIRS) analysis in acute, adult patients sustaining moderate and severe TBI. One of the aims of their investigation is to detect differences between patients with TBI and those with extracranial trauma (non-TBI), and this would certainly be useful to answering some of the greatest clinical challenges in the management of polytraumas in general, and brain trauma care in particular (12).

Previous studies attempted to assess the cerebral perfusion and vascular permeability after brain trauma by monitoring the kinetics of a contrast dye, indocyanine green (ICG), with NIRS device (13-19). However, Forcione et al. (11) are the first group to provide experimental evidence supporting the belief that the assessment of the ICG kinetic by contrast-enhanced NIRS could effectively help clinicians choosing the most suitable treatment for each patient, based on their levels of cerebral perfusion and BBB integrity.

This pilot study explored the possibility of retrieving distinct elements from the optical signal from the ICG kinetic between TBI and non-TBI patients, which can then be linked to differences in cerebral perfusion and BBB integrity. Future clinical trials with bigger sample sizes could explore the parameters suggested herein as markers for assessment of TBI patients.

The authors have also the merit to describe well the current challenges and limitations in the acquisition and analysis of optical data with regards to trauma patients.
These limits are discussed in depth, and their considerations could be relevant to the planning of future international clinical trials.

The clinical use of commercially available NIRS devices in hospital environments is still limited by a series of barriers: one of the biggest challenges is the training needed to provide clinical personnel with the practical skills to independently use point of care (PoC) diagnostics. With regards to NIRS, the lack of those competences will necessarily limit the possibilities to obtain data of sufficient quantity, and high quality, to monitor the ICG kinetic. However, these types of knowledge barriers go beyond the difficulties in acquiring reliable optical data, they also expose the critical importance of an effective organisation of trauma centres and their propensity toward continuous clinical and non-clinical improvement, which may well have repercussion in any other multicentre clinical study on TBI.

Another significant element exposed by this pilot study is the long time required for in vivo ICG spectral stabilization compared to in vitro studies. Based on the evidence acquired through their measurements, the authors also argue that the ICG spectral stabilization process may vary between patients. This is particularly relevant because in vitro studies showed a relatively quick spectral stabilization of the ICG, and multiple authors had previously suggested the ICG concentration could be translated into absolute values of physiological parameters in the assessment of conscious and unconscious TBI patients managed with maximum medical treatment or decompressive craniectomy (20-25). If the instability of ICG in vivo, as presumed according to this study, were to be confirmed by more in-depth analysis on larger sample sizes, the conclusions from Forcione et al. (11) may call into question the capacity to obtain absolute parameters of cerebral blood flow and BBB damage from optical analyses, where the ICG optical properties are considered stable.

In conclusion, the results of this pilot study represent a valuable add to the growing body of evidence on the adoption of new quantitative diagnostics (including PoC ones) meant to optimise the management of TBI patients (26-28). The take home message is sound and clear, as proposed by many neurotrauma research groups (29-30), it calls for engagement of multiple specialists, from neurosurgeons to neuroradiologists, from anaesthetists to intensivists, in adopting emerging methodologies, such as contrast-enhanced NIRS with ICG, for data collection, analysis, stratification and prognostication of TBI patients.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/qims-20-905). MG serves as an unpaid editorial board member of Quantitative Imaging in Medicine and Surgery. The other authors have no conflicts of interest to declare.

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Cite this article as: Ganau M, Iqbal M, Ligarotti GKI, Syrmos N. Breakthrough in the assessment of cerebral perfusion and vascular permeability after brain trauma through the adoption of dynamic indocyanine green-enhanced near-infrared spectroscopy. Quant Imaging Med Surg 2020;10(11):2081-2084. doi: 10.21037/qims-20-905