Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4612** Type: **Poster not-in-competition (Undergraduate Student) / Affiche non-compétitive (Étudiant(e) du 1er cycle)**

(UG) (POS-42) Effects of epidermal pigmentation on the accuracy of cerebral oximeters

Tuesday 28 May 2024 18:27 (2 minutes)

Introduction: The rise of the COVID-19 pandemic brought to light a stark disparity in the reliability of tissue oximeters, as racialized groups saw increased mortality rates due to undetected hypoxic conditions. Commercial tissue oximeters are based on Near Infrared Spectroscopy (NIRS) techniques that use a limited number of wavelengths of light to determine tissue oxygenation. However, it is well established that this approach is biased by high melanin content in the epidermis (i.e., in darker-skinned patients) due to its highly absorbing nature in the near-infrared region. Interestingly, the absorption spectrum of melanin has a monotonic decrease with wavelength, similar to the contribution of light scattering whose confounding effects can be mitigated by using dozens of wavelengths (i.e., hyperspectral oximetry). The objective of this study was to compare the accuracy of commercial and hyperspectral tissue oximetry in estimating the concentration of oxygenated hemoglobin (cHbO) in tissue-mimicking phantoms.

Methods: Solid phantoms of the human epidermis were made with varying concentrations of water-soluble nigrosine (a dye that mimics the absorption of human melanin) to replicate light, medium, and dark skin. These skin phantoms were placed on top of a liquid phantom that simulates fully oxygenated tissue conditions. Optical probes were secured to the surface of the skin layer for hyperspectral NIRS measurements. A no-skin condition (i.e, probes positioned in contact with the liquid phantom) served as reference for assessing the accuracy of the two methods. Commercial oximeter data was emulated by isolating data from several wavelengths. cHbO levels were determined using spectral derivatives and the Beer-Lambert Law for hyperspectral and commercial conditions, respectively. Statistical analysis employed independent sample t-tests ($p < 0.05$).

Results: Hyperspectral oximetry accurately determined cHbO in medium and dark pigmentation conditions, while the commercial system consistently underestimated cHbO across all skin tones.

Discussion: Hyperspectral oximetry is the superior technique to determine cHbO in darker skin pigmentation conditions. Current limitations of this work include the potential heterogeneity of the epidermal layers. Future work will seek to extend this comparison to more clinically relevant measures, such as tissue blood oxygen saturation.

Keyword-1

Near Infrared Spectroscopy

Keyword-2

Racial disparities

Keyword-3

Author: NICULESCU, Sophie

Co-authors: ESKANDARI, Rasa; KAMAR, Farah; DIOP, Mamadou

Presenter: NICULESCU, Sophie

Session Classification: DPMB Poster Session & Student Poster Competition (28) | Session d'affiches DPMB et concours d'affiches étudiantes (28)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)