Cerebral Tissue Oxygenation Impairment in Children with Pneumonia.

M. Lacerenza[1,*], V. Rossi[2], S. Zanelli[2], C.Amendola[3], D. Contini[3], M. Buttafava[1], G. Zuccotti[2,5], A. Torricelli[3,4] and V. Calcaterra[2,6]

[1]PIONIRS s.r.l., Milano, Italy; [2]Pediatric Department, Buzzi Children's Hospital, Milano, Italy; [3]Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; [4]Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Milano, Italy; [5]Department of Biomedical and Clinical Science, University of Milan, Milano, Italy; [6]Pediatric and Adolescent Unit, Department of Internal Medicine, University of Pavia, Pavia, Italy.
*mail: lacerenza@pionirs.com

INTERACT!

1. INTRODUCTION:

Pneumonia is a major concern in pediatric healthcare, due to its potential to cause severe tissue and cerebral hypoxia [1,2]. This condition can adversely affect neurological development [3], necessitating precise and timely monitoring. Standard clinical practices do not include continuous cerebral oxygenation monitoring in this specific population. Near-Infrared Spectroscopy (NIRS) is a valuable non-invasive technique for measuring the concentration of oxyhemoglobin (O_2Hb) and deoxyhemoglobin (HHb) in human tissues, including the brain, providing crucial insights into cerebral hemodynamics. Among NIRS methodologies, **Time-Domain NIRS** (TD-NIRS) offers superior precision and reproducibility, making it particularly suitable for clinical applications.

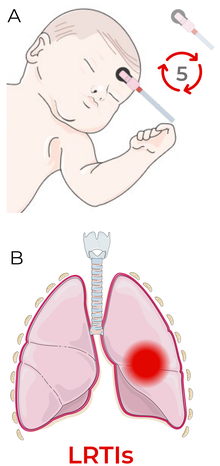

Figure 1 : A) Sketch of the G5 optical probe positioning on the prefrontal cortex, 5 re-applications. B) Simplified rapresentation of Lower Respiratory Tract Infections.

2. METHODS:

The study involved 60 participants, divided in 30 children with lower respiratory tract infections (LRTIs) and 30 age and sex matched healthy controls. TD-NIRS measurements were acquired with a **NIRSBOX tissue oximeter** (PIONIRS srl, Milan, Italy) [4], targeting the left frontal cerebral region, exploiting the "Goccia" G5 probe with 2.5 cm source-detector distance (Fig. 1 A).

Quantitative evaluation of cerebral tissue saturation (StO_2) and tissue total hemoglobin content (tHb) was performed real-time (1Hz acquisition frequency) across **5 repositioning of the optical probe** lasting 5 s each. Demographic and clinical data (hematocrit, SpO_2, heart rate, respiratory rate, BMI, head circumference) were collected for all participants. **A multiple logistic regression model** was used to explore significance of all acquired variables and their interplay in identifying pathological subject versus controls. Two-tailed t-tests have also been performed to check for significant differences in specific physiological values between controls and LRTIs patients (Fig. 2).

30 Healthy **30** Pathological

3. RESULTS:

Children with LRTIs exhibited cerebral StO_2 levels approximately 2.6 units lower than healthy controls (p = 0.002), Fig. 2. The multivariate logistic regression model identified **SpO_2, StO_2,** and **Respiratory Rate** as significant regressors in distinguishing LRTIs patients vs controls. Importantly, cerebral StO_2 values did not correlate with peripheral SpO_2 (pearson's r = 0.22), indicating that these two indicators may provide complementary information.

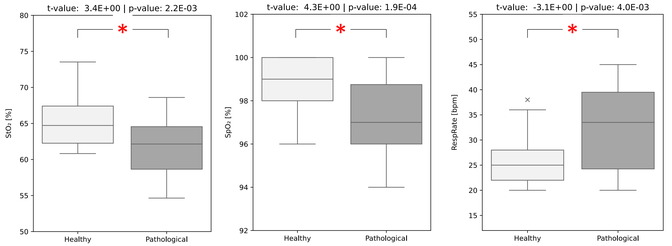

Figure 2 : Boxplots of average values of measured physiological parameters, t-test results on the top. Healthy (light gray) vs pathological (dark gray) subjects. Red asterisks show significant differences between groups (p-value <0.05, two tailed t-test) .

The logistic regression model including cerebral oximetry data from TD-NIRS showed higher area under the Receiver Operating Characteristic (ROC) curve compared to the one without them (Fig. 3).

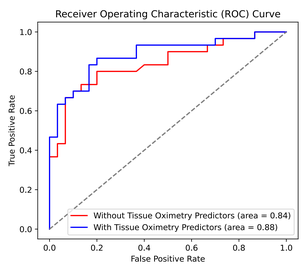

Figure 3 : Comparison of the ROC curve resulting form the logistic regression model including cerebral tissue oximetry (Blue) vs without it (Red).

4. CONCLUSIONS

Cerebral StO_2 was one of the key and independent predictors of LRTIs (odds ratios = 0.45, p-value = 0.002), suggesting that **LRTIs could significantly effected cerebral saturation** in children. Cerebral StO_2 might therefore be an additional parameter to record for better assessing the condition of LRTI patients. These findings highlight the role of TD-NIRS in providing deeper insights into brain oxygenation in pediatric patients, indicating **potential independence of peripheral oxygen saturation**

5. REFERENCES:

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