

The spontaneous desaturations in systemic oxygen may have occurred for a variety of reasons; none were recorded during seizures. The changes in cerebral oxygenation and oxygen utilization we recorded will vary depending on the cause of the desaturation, and the other physiological changes such as CO₂, HR and MABP which were not corrected for in this study, but were generally of low values during the desaturations studied. CO₂, HR and MABP have a large effect on the cerebral oxygenation and metabolism [36], so in future work we will use a method that considers multiple systemic variables, for example, canonical correlation analysis [39] or mixed model analysis [14]. We will also investigate differences between the days of measurements and treatments (i.e. during or post-TH). We are continuing to study further subjects and will expand our analysis to these neonates.

Our system has the capacity for SRS measurements to derive haemoglobin saturation using the multiple detectors per channel [40]. We plan to apply this technique to the data already recorded to calculate absolute measurements of haemoglobin saturation, such as TOI. Multidistance measurements can also be used to separate changes in the superficial layers above the cerebral cortex using a two-layer model [41], we will also investigate the application of this method to our current and future data. In addition, we also have the capacity to perform imaging with a different arrangement of the detector fibres; the combination of the multiple individual detector optodes and 3-dimensional printing to create optode holders means that the system is flexible to imaging as well as spectroscopy.

5. Conclusion

We have developed and described a new broadband NIRS system called CYRIL to simultaneously measure the changes in cerebral tissue oxygenation, haemodynamics via estimation of the changes in haemoglobin concentrations; in addition to metabolism and oxygen utilization via the measurement of the oxidation state of CCO. We have used CYRIL in the newborn infant with neonatal encephalopathy in the NICU for continuous periods over up to 5 days.

NIRS data was collected simultaneously with systemic data to allow multimodal data analysis. This allowed us to study the NIRS variables in response to global pathophysiological events and we have focused our analysis to spontaneous oxygen desaturations. We have shown with a feasibility study in 6 NE infants that the relationship between haemoglobin oxygenation changes and cytochrome-c-oxidase oxidation changes during these desaturation events was significantly correlated with the MRS-measured Lac/NAA biomarker of injury severity.

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