frequency-domain spectroscopy of turbid media: from milk to brain

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instrument development

first ISS prototype

first bench-top generation

latest generation

http://www.iss.com
measurements in liquid phantoms


measurements in solid phantoms

Measurements in animals


measurements in various human body-parts
arterial occlusion $\rightarrow$ oxygen consumption


optical mammography


Δ[Hb] (μM)

finger tapping

Δ[Hb] (μM)

[Image of a hand with a diagram showing finger tapping and changes in [Hb] over time.]
modulation of $\text{FiO}_2$
measuring brain development with FD-NIRS

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PET study of glucose utilization: a measure of developmental trajectory

PET

- **newborn** - a) sensorimotor cortex, b) deeper brain structures
- **2-3 months** - a) parietal, b) occipital, c) temporal, f) metabolic activity in the frontal cortex remain low
- **8 months** - a) lateral frontal, and then b) mesial frontal cortex

regional increases in PET correlate with active synaptogenesis, myelination, regional increases in CBF & CBV, behavioral development & infant skills

these changes in blood flow and myelination must also reflect the anatomic evolution of the cerebral vasculature

hypothesis

NIRS can be used to assess early brain development
we recruited 47 healthy infants age from premature to 12 months old
30 males
average gestational age at birth
37.9 wks (27.0-41.5)
we positioned the probe on 6 different regions of the head and hold it in place for the 8 s of data acquisition.

In 60% of the infants we repeated measurements multiple times.
results - frontal cortex
we utilized FD-NIRS to follow brain development in healthy infants during the first year of life.

measurements in multiple brain regions ⇒ region specific longitudinal increases in metabolic and vascular growth.
⇒ results in agreement with known behavioral and physical development and with PET studies of changes in cerebral metabolism.

tissue oxygenation relatively constant with age and location ⇒ tight control mechanism between oxygen delivery and local cortical consumption in healthy infants.

significant change in oxygenation during transition from fetal to adult hemoglobin.
⇒ low oxygenation values at this age may be critical in infants at risk.

results demonstrate utility of FD-NIRS as a gold standard non-invasive method for assessing brain development in infants.
buon compleanno Enrico e grazie