Concordance with Changes in Total Hemoglobin Proves Regional Oxygen Saturation Can Be Used to Study Cerebral Autoregulation in Neonates

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Introduction

Problem : impaired cerebral autoregulation
Solution : detect ΔHbT concordant with ΔMABP (with ΔSaO_2=0)
But ..
Problem : HbT (=HbO_2+Hb) is not absolute
Solution : prove that rSO2 may replace HbT for measurement of impaired cerebral autoregulation

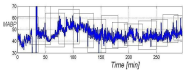
Acronyms :
- ***MABP :*** mean arterial blood pressure
- ***HbT :*** total hemoglobin
- ***SaO_2 :*** arterial oxygen saturation
- ***rSO_2 :*** regional oxygen saturation

Datasets

- 14 premature infants with need for intensive care
- MABP, SaO_2, and rSO2 measured simultaneously in the first days of life at the University Hospital Utrecht
- dHbT values (differential HbT) computed manually from the optical densities at 810nm of the two detectors of the INVOS4100 (Somanetics, USA)
- rSO2 measured by NIRS (with INVOS4100)
- Post menstrual age: 29 2/7 weeks (std: 1 2/7)
- Weight: 1130.67g (std: 311.36)
- Recording time: 49h36min (std: 11h48min)

Methods > Scores

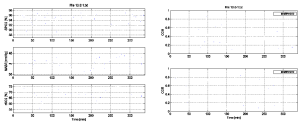
- Correlation and (partial[1]) coherence coefficients to look at the *linear* concordance between signals MABP/HbT and MABP/rSO2
- Frequency band of interest: 0.0042 - 0.0167*Hz (60-240s)*
- *Sliding window approach*[2]: scores computed over 8-min epochs



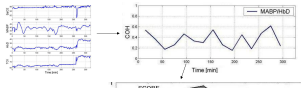
- SaO_2 kept in the range 80-100%

[1] **Louridan et al**, 1985.
[2] **Morren et al**, 2001.

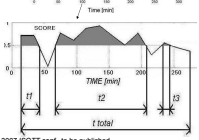
Methods > Scores



Methods > Synthesizing measures



Critical Percentage of the Recording Time (%) *(CPRT)*

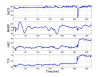


De Smet et al. *Proc. of the 2007 ISOTT conf.*, to be published.

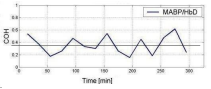
Methods > Synthesizing measures

Problem : the score value differs from one epoch to another one: not handy to use

Solution : a measure that synthesizes the level of autoregulation of a patient for the whole recording time



Mean Score *(mCOR, mCOH, and mPCOH)*



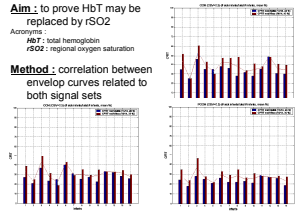
Tsuji et al., *Pediatrics*, 2000.

Methods > Similarity measures

Aim : to prove HbT may be replaced by rSO2

Acronyms :
- ***HbT :*** total hemoglobin
- ***rSO2 :*** regional oxygen saturation

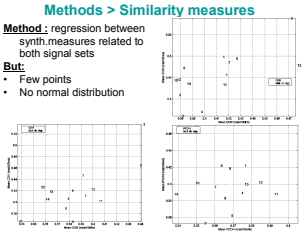
Method : correlation between envelop curves related to both signal sets



Methods > Similarity measures

Method : regression between synth.measures related to both signal sets

But:
- Few points
- No normal distribution



Conclusion

- rSO2 can be used to assess impaired cerebral autoregulation in neonates

Methods > Similarity measures

Method : generalized linear mixed models with a compound symmetry covariance structure: we considered the scores between MABP/HbT and between MABP/rSO2 as two measurements from the same underlying variable, and we assess if there is any difference between these two.

	p-value	*Value dHbT vs value rSO2*
mCOR	<0.01	-0.05 per 1
mCOH	<0.01	-0.04 per 1
mPCOH	<0.01	-0.03 per 1
CPRT COR	<0.01	-8.0 per 100
CPRT COH	<0.01	-4.9 per 100
CPRT PCOH	<0.01	-6.3 per 100

Acronyms :
- ***mCOR/mCOH/mPCOH:*** mean score
- ***CPRT:*** crit. percentage of the rec. time